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GEOLOGY.—*Sun symbol markings.*[1] WALTER B. LANG, U. S. Geological Survey. (Communicated by Roland W. Brown.)

Situated high upon a mesa spur at the confluence of Fewkes and Cliff Canyons in Mesa Verde National Park, Colorado, is Sun Temple. This ceremonial house was left uncompleted by the Indians when, for an unknown reason, they abandoned Mesa Verde. In 1915, when this ruin was excavated from an accumulation of debris that had become overgrown with cedars, pinyons and brush there was discovered at the southwest corner a peculiarly marked stone (Fig. 1) which was described by Fewkes[2] as follows:

> This cornerstone (has) a central depressed zone with sharp radiating ridges. . . . A natural object with these characters would greatly affect a primitive mind, and no doubt was regarded with more or less reverence by the builders. . . . At all events, they have partially enclosed this emblem in walls in such a way as to enclose the figure on three sides. There can be no doubt that the walled enclosure was a shrine and the figure in it may be a key to the purpose of the building. The shape of the figure on the rock suggests a symbol of the sun, and if this suggestion is correct, there can hardly be a doubt that solar rites were performed about it long before Sun Temple was built.

Fewkes further notes that a person sitting in the shrine on September 21 observes the setting sun directly before him.

Various explanations have been given for this natural figure. It has been referred to as the impression of a palm leaf[3] and as a fossil Cretaceous spring.[4] Neither of these explanations seems to be an adequate interpretation of its origin. The writer's attention was focused upon these radial markings subsequent to a visit to Mesa Verde in 1931. Undoubtedly on many previous occasions he had casually seen similar marks on rock exposures for since then they have been observed on the weathered surfaces of many limestone and limy

[1] Published by permission of the Director, U. S. Geological Survey. Received January 15, 1937.

[2] FEWKES, J. WALTER. *Excavation and repair of Sun Temple, Mesa Verde National Park.* Dept. of the Interior, Washington, pp. 20–21, 1916.

[3] Mesa Verde National Park guide book, Dept. of the Interior, Washington, p. 12, 1916.

[4] Mesa Verde National Park guide book, Dept. of the Interior, Washington, p. 35, 1927.

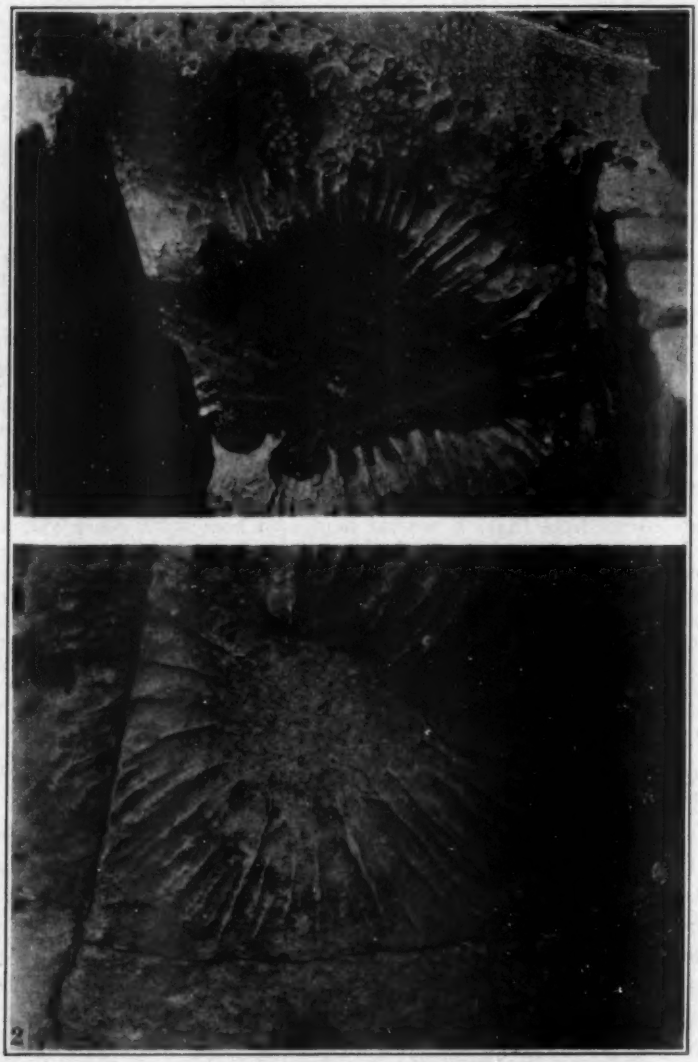


Fig. 1.—Sun Symbol, southwest corner of Sun Temple, Mesa Verde National Park, enshrined by protecting walls built by the Cliff Dwellers. Distance between buttresses approximately two feet. Fig. 2.—Sun Symbol mark taken from the rim rock of Mesa Verde National Park, near Balcony House. Diameter of bowl averages 7 inches, depth 2 inches. Radial ridges extend outward 8 inches. Lichen growth show whitish in the lower right hand corner. Jointing cracks of recent origin are younger than the Sun Symbol. Specimen now in the U. S. National Museum. Photograph by C. Marshall Finnan.

sandstone beds throughout the Southwest, more particularly on the San Andres limestone, the Carlsbad limestone in the Carlsbad Caverns National Park and sandstone beds of the Carlsbad limestone in upper Dark Canyon, New Mexico, the Comanche limestones of West Texas, and the Kaibab limestone at the Powell Memorial Monument, Grand Canyon. In consideration of the general distribution of these erosion figures as a common phenomenon on certain types of rocks and the preservation of one of them at Sun Temple it seems appropriate to designate them as Sun Symbol[5] markings.

Through the courtesy of the National Park Service a specimen of Sun Symbol marking was sent to the writer from Mesa Verde National Park in 1933 and Mr. C. Marshall Finnan, who made the selection from some twenty or more markings that are already known to exist there, thus describes their occurrence:

> As a general rule these "Sun Symbols" are found along the canyon rims at the southern end of the mesa among the pinyon and juniper forest. They are only found in one particular brown layer of the Mesa Verde sandstone. This layer, about 4 feet thick, lies just beneath the red top soil and is exposed along the rim of the canyons. It is at these exposed places only, that these peculiar erosive characters are evident.

The Sun Symbol markings at Mesa Verde (Fig. 2) usually range from 1 to 2 feet in diameter. They are composed of two parts—a central bowl or basin from 1 to 6 inches deep and a fringe of radial ridges and furrows surrounding the bowl. The figure is usually circular in form and the length of the furrows is about equal to the diameter of the central basin. At their outer ends these furrows blend into the irregularities of the rock surface but where they descend into the bowl they become more prominent by forming troughs which in some instances are as much as an inch in depth. Near the margin of the bowl the radial ridges and troughs plunge downward at an angle whose steepness usually depends upon the depth of the bowl. The Sun Symbol marking looks like a large sunflower impressed in rock.

A vertical section cut across the Mesa Verde specimen (Fig. 3) exposed a buff colored sandstone of even texture composed of angular quartz grains 0.15 mm in diameter, cemented by silica with considerable calcium carbonate and hydrous iron oxide. Though treatment of a sample of the rock with hot hydrochloric acid removed completely the iron oxide and calcium carbonate, an almost imperceptible amount of silica cement still held the grains in place. The rock is of

[5] The insignia of the State of New Mexico, the Indian Zia sign or sun symbol, is very similar in form to these natural figures.

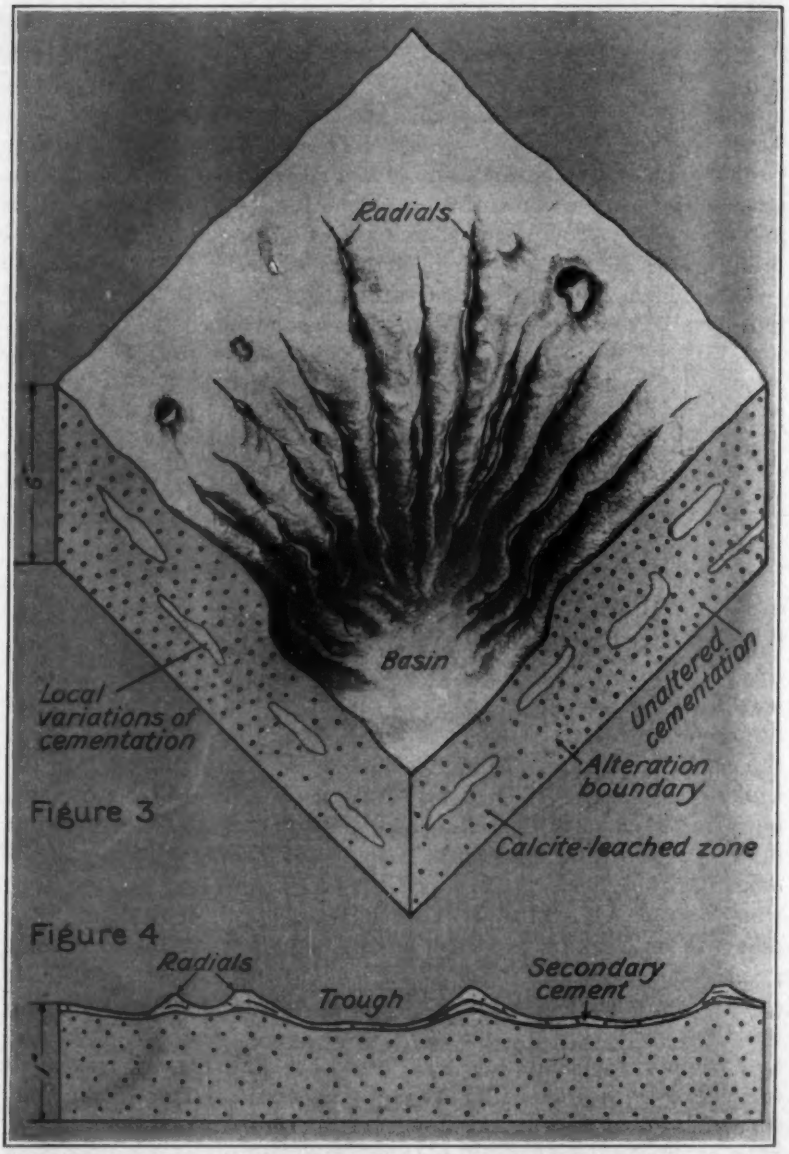


Fig. 3.—A sectional diagram of a Mesa Verde Sun Symbol. Fig. 4.—A section made across the area of the radial zone showing the thin band of secondary cement that is deposited at the surface by the evaporated rain water. Note that the band of cement is thickest beneath the radials.

very uniform texture, but horizontal stratification is suggested by the orientation of slight variations in the cementing materials. On the cut surface splotches one half to three quarters of an inch long are pale buff or whitish due to a greater concentration of calcite, whereas other patches are slightly darker brown from a concentration of iron oxide. Most of the coloration areas have gradational boundaries; a few are sharply defined. The major axes of these coloration areas lie parallel to the bedding plane.

On the weathered surface of the sandstone is a dark, thin, well-defined band 1 to 3 mm deep. This band or capping is thicker over the ridges than in the troughs or furrows. It contains a concentration of calcium carbonate and iron oxide, and effervesces actively when treated with hydrochloric acid. Beneath this thin layer lying within the bowl, the calcium carbonate cement is almost negligible whereas the iron oxide content appears relatively constant throughout the rock except for the small patches above mentioned. Much of the calcite cement has been leached from below the bowl, though the original amount of cementation here may have been less than in the surrounding portion of the rock.

When a rock of uniform texture is exposed to weathering, differences in degree and kind of cementation vary the rate of erosion and a smooth surface may soon become irregular and pitted. Rain water falling through the air and in its travels upon the surface of the ground soon acquires carbonic and organic acids and thus becomes a solvent of rock cements. In percolating downward into the sandstone the water dissolves the binding cement and frees the quartz grains, which, subsequently, are removed by wind, water, and other agencies of transportation. The more permeable areas of the rock are relatively more easily weathered and form initial hollows that catch surface water, thus forming pockets or basins (tinajita) that tend to deepen and expand with each ensuing shower. So long as the rocks remain moist and the climate relatively humid, downward percolation of rain water is the dominant process, but in the semi-arid Southwest another important agency comes into play. There the greatest amount of the annual precipitation falls during thunder showers in the summer months when the air is dry and warm. The porous surface rocks quickly become saturated during one of these downpours, but dry out rapidly after the storm has passed. Some of the absorbed moisture descends to the water table or an aquifer but most of it in the upper part of the rock is drawn to the surface by capillarity or by plants and evaporated. The water thus leaves the dissolved mineral

matter at or near the surface. Where irregularities develop, protruding slightly above the general level, more rapid evaporation takes place and therefore more dissolved salts are deposited, thus serving to restrain erosion in those areas. The lower areas accumulate more water, suffer more solution, and acquire less salts. Therefore, a differential action is set up, bringing into greater relief the initial variations in surface expression.

As a depression forms, it becomes a center for accumulation of rain water. Rills[6] develop upon the rim, extending outward as they conduct more and more water to the central basin, and deepen to form radial troughs. If the depression deepens rapidly, the radial lines and troughs follow down into the basin as well as grow farther outward. The Sun Symbol mark is therefore a transient impression made upon the weathering surface of rock and persists only so long as the conditions favoring its development are operative. They must come and go as the rock surface is worn down. Thus the Sun Symbol mark is the product of erosion on sandstones so constituted as to initiate these surface effects.

So far only Sun Symbol marks in limy sandstones have been considered. Sun Symbol marks are probably far more numerous in limestones but apparently less conspicuous. They depend upon the same process for their formation. Hill and Vaughn noted the presence of rills (Karrenfelder) on the Edwards limestone.[7] Solution-faceted pebbles,[8] conspicuously developed in the Pecos Valley, are small examples of the process of solution. In western Texas the Permian limestones, but more especially the blocky exposures of Cretaceous limestone, present cupped weathered surfaces with hard upturned edges bounding the joint planes. As noted by Udden,[9] algae are present upon the rocks and in the bowls of these depressions but to what extent their products of metabolism contribute to the evolution of the pocked surfaces is not clearly understood. It is, however, evident that rills on rock surfaces do develop quite independently of organisms.

In his description of pebbles (later called solution-faceted pebbles by Bryan) he had seen in the river gravels of the Rio Grande near

[6] LAUDERMILK, J. D., and WOODFORD, A. O. *Concerning Rillensteine.* Am. Jour. Sci. 23: 135–154. 1932.

[7] HILL, R. T., and VAUGHN, T. W. *Geology of the Edwards Plateau and Rio Grande Plain adjacent to Austin and San Antonio, Texas; with reference to the occurrence of groundwaters.* U. S. Geol. Survey 18th Annual Report, pt. 2, p. 229, 1896–97.

[8] BRYAN, KIRK. *Solution-faceted limestone pebbles.* Am. Jour. Sci., 5th ser. 18, 105: 193–208. 1929.

[9] UDDEN, J. A. *Etched potholes.* Texas Univ. Bull. 2509: 5–9. 1925.

Eagle Pass, Texas, Udden referred thus to furrowings on their surfaces: "In very rare cases one may see etched grooves radiating from the elevated center of one of the flattened surfaces of these boulders."[10] This no doubt is but a reversal of the direction of flow of the dissolving water that produces the Sun Symbol mark. Again quoting Udden: "This radiated, furrowed sculpture is one of the most common sculpture forms seen on the bare limestone surfaces in situ in this part of America." This suggests that he had recognized radial patterns caused by an outward flow of water.[11]

So far no cuspated potholes or radial erosion marks have been reported from humid regions[12] where on similar rocks marginal erosion may exceed that taking place over the central portion and the surfaces tend to become convex. In arid or semi-arid climates the marginal areas may receive a protecting deposit of salts, concentrated there by the wick-like action of the rim during the process of solution by rain water and its subsequent evaporation, and so develop concave surfaces.

BOTANY.—*New species of* Paspalum *from Tropical America.*[1] AGNES CHASE, Bureau of Plant Industry.

Three of the species here proposed belong to the Decumbentes, a group of *Paspalum* characterized by the development of the first glume in the lower of the pair of spikelets, sometimes in the upper also. The species, except *P. nutans* Lam. which is found also in Mauritius, are confined to the American tropics and warm temperate regions.

Paspalum Hintoni Chase, sp. nov.

Perenne; culmi ascendentes, 30–45 cm alti, compressi; vaginae carinatae; laminae planae, 3–6 cm longae, 2–5 mm latae, hirsutae; racemi solitarii, longe pedunculati, terminales et axillares, 4–7 cm longi; spiculae geminae, 2.2–2.3 mm longae, 1.2 mm latae, glabrae; gluma prima nulla aut minutissima, gluma secunda spiculam dimidiam subaequans; lemma sterile 3-nerve; fructus subtilissime papilloso-striatus.

Perennial, in small tufts; culms ascending, slender, compressed, 30–45 cm tall, the nodes appressed-pubescent; sheaths compressed-carinate, ciliate

[10] UDDEN, J. A. *Flattening of limestone gravel boulders by solution.* Geol. Soc. America Bull. 25: 66–68. 1914.

[11] Large steep-sided sandstone boulders in the Dog Canyon area of the Guadalupe Mountains show these centrifugal troughs. Also where the dolomitic anhydrites of the Rustler formation are exposed in the Pecos Valley a fine display of large well-developed vertical rills is to be seen.

[12] HUMMEL, K. *Lösungserscheinung auf Kalkstein an der dalmatinischen Küste.* Natur und Museum 62: 381–382. 1932. A solution figure (sun symbol) developed in limestone on the Dalmatian coast under conditions simulating those of a semi-arid climate.

[1] Received January 28, 1937.

on the margin and hirsute at summit; ligule about 0.7 mm long; blades flat, spreading, 3 to 6 cm long, 2 to 5 mm wide (the uppermost reduced) papillose-hirsute on both surfaces; racemes solitary, terminal and axillary, on long slender peduncles, usually two from the uppermost sheath, 4 to 7 cm long, subarcuate, the rachis about 1 mm wide, pubescent at the very base, otherwise glabrous; spikelets in pairs, 2.2 to 2.3 mm long, about 1.2 mm wide, slightly purple tinged; first glume obsolete on both spikelets of the pair or developed as a very minute truncate scale on a few spikelets; second glume about half as long as the spikelet, 3-nerved; sterile lemma rather firm in texture, 3-nerved, its membranaceous palea well developed but empty; fruit about 2.1 mm long, pale, minutely papillose-striate.

Type in the U. S. National Herbarium no. 1611719, collected at 1,080 meters altitude at Vigas, Temascaltepec District, State of Mexico, Mexico, September 22, 1932, by George B. Hinton (no. 1807). This is part of a single specimen received for study from Kew Herbarium and returned to that institution.

The species is closely related to *Paspalum pilosum* Lam., and *P. Peckii* F. T. Hubb., differing from both chiefly in the smaller spikelets and short second glume. It differs also in that the first glume is alike in both spikelets of the pair, whereas in *P. pilosum* and *P. Peckii* the first glume is unequally developed in those of the pair.

Paspalum Altsoni Chase, sp. nov.

Perenne; culmi ramosi, decumbentes; laminae planae, 5–11 cm longae, 5–11 mm latae; pedunculi 2–4 e vagina suprema; racemi solitarii, 2–5 cm longi; spiculae geminae, 2.5–2.7 mm longae, circa 1.5 mm latae; gluma prima spiculae superioris parva, ea spiculae inferioris quam spicula 2–4-plo brevior; gluma secunda et lemma sterile 5-nervia, gluma quam lemma brevior; fructus subtilissime papilloso-striatus.

Perennial in small tufts; culms spreading or prostrate, freely branching, the branches somewhat divergent; sheaths loose, shorter than the internodes, or the lower overlapping, glabrous or the margin ciliate toward the summit; ligule about 2 mm long; blades flat, 5 to 11 cm long, 5 to 11 mm wide (the uppermost somewhat reduced), slightly narrowed to a rounded base, very sparsely pilose on the upper surface near the base or glabrous, the margin finely fluted below, the pale midnerve prominent beneath; peduncles 2 to 4 from the upper and middle sheaths, subfiliform, finally long-exserted, the later axillary ones concealed in the sheaths until the maturity of the primary racemes; racemes solitary, 2 to 5 cm long, straight or slightly arcuate, the rachis slender, slightly channeled; spikelets in pairs, the pairs somewhat distant, 2.5 to 2.7 mm long, about 1.5 mm wide, elliptic-obovate; first glume small and nerveless on the upper spikelet of the pair, 1-nerved, subacute and one-quarter to one-half as long as the spikelet on the lower spikelet, both glabrous or with a few weak hairs; second glume and sterile lemma 5-nerved, rather firm in texture, with a few scattered hairs or glabrous, the glume slightly shorter than the spikelet; fruit nearly the size of the spikelet, pale-stramineous, minutely papillose-striate.

Type in the U. S. National Herbarium no. 1539437, collected in moist sandy crevices on rocks in the open, at about 75 meters altitude, Macreba Falls, "Kurapung River," in the upper Mazaruni District, British Guiana, September 3, 1925, by R. A. Altson (no. 392).

In this species the habit and foliage resemble those of *Paspalum decumbens* Swartz and *P. nutans* Lam., but the spikelets are larger with the first glumes of the pair dissimilar as in *P. pilosum* Lam. and its close allies.

Paspalum petilum Chase, sp. nov.

Perenne; culmi graciles, ascendentes, 15–22 cm alti, foliosi; laminae planae, 3–10 cm longae, 3–4 mm latae, glabrae; pedunculi 2–3 ex vagina suprema; racemi solitarii, terminales et axillares, 1–2.5 cm longi, arcuati; spiculae geminae, 1.7–1.8 mm longae, circa 1.1 mm latae; gluma prima parva, obtusa, in margine pubescens; gluma secunda et lemma sterile pubescentia; fructus subtilissime papilloso-striatus.

Perennial in small tufts; culms slender, ascending or spreading, 15 to 22 cm tall, leafy throughout, the uppermost blade often equaling the inflorescence; nodes appressed-pubescent to glabrescent; sheaths mostly overlapping, densely pubescent along the margin and on the collar; ligule about 1 mm long; blades flat, 3 to 10 cm long, 3 to 4 mm wide, tapering to the often folded base, glabrous, the pale midnerve prominent beneath; peduncles 2 or 3 from the upper sheath, filiform; racemes solitary, 1 to 2.5 cm long, arcuate, the rachis slender, slightly channeled; spikelets in pairs, scarcely crowded, 1.7 to 1.8 mm long, about 1.1 mm wide, elliptic-obovate; first glumes similar on the spikelets of the pair, short, obtuse, nerveless, pubescent on the margin; second glume and sterile lemma 3-nerved or obscurely 5-nerved, sparsely pubescent, the glume two-thirds or three-fourths as long as the spikelet; fruit about 1.6 mm long, pale, very minutely-papillose-striate.

Type in the U. S. National Herbarium no. 1298462, collected on wet rocks, China Creek, Konawaruk River [County of Essequibo], British Guiana, September 1906, by A. W. Bartlett (Bot. Gard. Georgetown Herb. no. 8569).

In habit this species resembles *Paspalum dispar* Chase, of Hispaniola, but differs in having smaller pubescent spikelets and first glumes similar on the spikelets of the pair. In *P. dispar* the glume on the lower spikelet is about two-thirds as long as the spikelet.

Paspalum ionanthum Chase, sp. nov.

Perenne, caespitosum; culmi ascendentes, 15–40 cm alti, paucifolii; vaginae compressae; laminae planae aut subinvolutae, 0.5–8 cm longae; racemi 2, subconjugati, ascendentes, 3–5.5 cm longi; spiculae solitariae, 3.4–3.7 mm longae, circa 1.5 mm latae, ellipticae, glabrae, saepius purpurascentes; gluma et lemma sterile aequalia, 5-nervia, minute apiculata; fructus subtilissime papilloso-striatus.

Perennial in dense hard tufts with numerous short leafy sterile shoots at base; culms ascending, compressed, 15 to 40 cm tall, with a single node above the base; sheaths compressed, those of the sterile shoots short, overlapping, sparsely hirsute to glabrous, mostly stiffly ciliate, at least toward the summit, those of the culms longer, glabrous; ligule almost obsolete; blades firm, flat to subinvolute, those of the sterile shoots 5 to 8 cm long, 2 to 5 mm wide, those of the culms 0.5 to 4 cm long, all ciliate at the very base; racemes 2, subconjugate, ascending, 3 to 5.5 cm long, the rachis about 0.8 mm wide, with a few hairs at base, otherwise glabrous, one of the pair usually naked at the very base; spikelets solitary, 3.4 to 3.7 mm long, about

1.5 mm wide, elliptic, glabrous, mostly purple-tinged; glume and sterile lemma equal, rather firm in texture, 5-nerved, minutely apiculate at the subacute apex; fruit pale, about the size of the spikelet, minutely papillose-striate.

Type in the U. S. National Herbarium no. 1037280, collected in the region of Lake Ypacaray, in central Paraguay, in December 1913, by Dr. E. Hassler (no. 12383).

This species belongs in the Notata group and is most nearly related to *P. almum* Chase, of Texas, southern Brazil, and Paraguay. It differs from that in the numerous short sterile shoots, the shorter much firmer blades, in the shorter stiffer racemes, and in the larger spikelets. The type collection was named by Dr. Hassler as a variety of *Paspalum notatum* Flügge. The varietal name is unpublished and cannot be used as a specific name because it is preoccupied.

Paspalum almum was described[2] from Texas. At the time I hesitated to cite the South American specimens, but further study leaves no doubt that they belong to the same species as the Texas material. Three racemes are not infrequent in the South American specimens and in one specimen there are 5 and in another 6 racemes. A specimen of this species, No. 21 *Plantae Pilcomayenses*, collected in 1906 in the Gran Chaco by Theodore Rojas, custodian of the Hassler Herbarium, was described by Hackel as *Paspalum ovale* Nees var. *apiculatum* Hack.[3] An examination of Nees' type of *P. ovale*, in the Berlin Herbarium, shows that it is not the species to which Hackel applied the name. The name "apiculatum" could not be used because it is preoccupied by *P. apiculatum* Doell, 1877.

The following South American specimens are referred to *Paspalum almum:*

BRAZIL: Porto Esperança, on Rio Paraguay, Matto Grosso, *Chase* 11078, 11095, 11109.

PARAGUAY: Gran Chaco, *Rojas* 21. Puerto Santa Rita, *Rojas* 2675 (*Hort. Paraguayensis* 11071). Rio Verde, *Herter* 4831. San Bernardino, *Rojas* 1660. Lake Ypacaray, *Hassler* 12334.

URUGUAY: Santa Rosa Cuareim, *Herter* 336 i (*Herter Herb.* 82565).

ARGENTINA: Mercedes, Prov. Corrientes, *Parodi* 6370. Formosa, *Parodi* 2936 (collector unknown).

ZOOLOGY.—*North American monogenetic trematodes.* I. *The superfamily Gyrodactyloidea.*[1] EMMETT W. PRICE, U. S. Bureau of Animal Industry.

Genus DAITREOSOMA Johnston and Tiegs, 1922

Diagnosis.—Body with constriction about one-third of length from an-

[2] This JOURNAL 23: 137, fig. 1, 1933.
[3] Repert. Sp. Nov. Fedde 6: 341. 1909.
[1] Continued from This JOURNAL, 27: 114–130. 1937.

terior end; 3 pairs of head organs. Haptor not distinctly set off from body proper, with 2 pairs of large hooks—ventral pair larger than dorsal—articulating at their bases with a long, transverse, cuticular bar, and with 1 pair of marginal hooklets. Eyes present. Intestinal branches without diverticula, united posteriorly. Vitellaria not extending into posterior third of body. Vagina present.

Type species.—Daitreosoma constrictum Johnston and Tiegs, 1922.

Two species, *D. constrictum* from *Therapon carbo* Ogilby and McCulloch, and *D. bancrofti* from *T. hilli* Castelnau, have been described from Australia by Johnston and Tiegs (1922); neither of these species is known from North American hosts.

Genus EMPLEUROSOMA Johnston and Tiegs, 1922

Diagnosis.—Body with strongly developed lateral regions; 4 pairs of head organs. Haptor not distinctly set off from body proper, with 2 pairs of large hooks and 1 pair of marginal hooklets as in *Daitreosoma*. Vagina absent. Other characters as in *Daitreosoma*.

Type species.—Empleurosoma pyriforme Johnston and Tiegs, 1922.

This genus contains only the type species; it was described from the gills of an Australian fresh-water fish, *Therapon unicolor* Gunther.

Genus ANCHYLODISCUS Johnston and Tiegs, 1922

Diagnosis.—Body without lateral constrictions and without strongly developed lateral regions. Haptor not distinctly set off from body proper, with 2 pairs of very large hooks supported by 2 cuticular bars, and with 14 marginal hooklets. Intestinal branches without diverticula and not uniting posteriorly. Eyes present. Vitellaria extending into posterior third of body. Vagina absent.

Type species.—Anchylodiscus tandani Johnston and Tiegs, 1922.

Two species have been described as belonging to this genus, namely, *A. tandani* Johnston and Tiegs from the gills of *Tandanus tandanus*, and *A. gadopsis* Hughes from the gills of *Gadopsis* sp.; both species are from Australian hosts.

Genus MURRAYTREMA Price, 1937

Diagnosis.—Cephalic glands opening to exterior through 4 pairs of head organs. Haptor large, with 2 pairs of large hooks separated by 3 transversely placed non-articulate bars; 14 marginal hooklets. Intestinal branches not uniting posteriorly. Eyes present. Testis and ovary in equatorial zone. Cirrus with accessory piece. Vagina present, opening ventrally and medially.

Type species.—Murraytrema robusta (Murray, 1931) n. comb.

The type and only species of the genus was described as *Ancyrocephalus robusta* by Murray (1931) from specimens collected from the gills of *Sparus australis* Gunther in Australia. *Murraytrema* (Price, 1937) differs from *Ancyrocephalus* in having 3 haptoral bars instead of 2 as in the latter genus, and the vagina opens ventrally and medially in *Murraytrema* and laterally in *Ancyrocephalus*.

Genus Cleidodiscus Mueller, 1934

Diagnosis.—Cephalic glands opening to exterior through several (4 to 6) pairs of head organs. Haptor discoid, with 2 pairs of large hooks separated by 2 non-articulated bars, and with 14 marginal hooklets. Eyes present. Testis and ovary in equatorial zone. Cirrus simple, with movable accessory piece. Vitellaria extending into posterior third of body. Vagina present, opening on left body margin.

Type species.—*Cleidodiscus robustus* Mueller, 1934.

The genus *Cleidodiscus* contains the following species, all being from North American fresh-water fishes: *Cleidodiscus bedardi* Mizelle, 1926, from *Xenotis megalotis* (Rafinesque); *C. capax* Mizelle, 1926, from *Pomoxis sparoides* (Lacépède); *C. floridanus* Mueller, 1936, from *Ictalurus punctatus* (Rafinesque); *C. formosus* (Mueller, 1936), from *Pomoxis sparoides* (Lacépède); *C. incisor* Mizelle, 1936, from *Lepomis pallidus* (Mitchill); *C. longus* Mizelle 1936, from *Pomoxis sparoides* (Lacépède); *C. mirabilis* Mueller, 1937, from *Leptops olivaris* (Rafinesque); *C. pricei* Mueller, 1936, from *Ameiurus natalis* (Le Sueur) and *A. nebulosus* (Le Sueur); *C. nematocirrus* Mueller, 1937, from *Eupomotis gibbosus* (Linn.); *C. robustus* Mueller, 1934, from *E. gibbosus* (Linn.) and *Lepomis pallidus* (Mitchill); *C. stentor* Mueller, 1937, from *Amboplites rupestris* (Rafinesque); *C. uniformis* Mizelle, 1936, from *Pomoxis annularis* Rafinesque; and *C. vancleavei* Mizelle, 1936, from *P. annularis* Rafinesque.

Genus Actinocleidus Mueller, 1937

Diagnosis. Haptor disc-like, flattened, with 2 pairs of large hooks, similar and about equal in length; haptoral bars with bases articulating; 14 marginal hooklets. Cirrus with movable accessory piece. Vagina present, opening on left body margin. Other characters as in *Cleidodiscus*.

Type species.—*Actinocleidus oculatus* (Mueller, 1934) Mueller, 1937.

Representatives of this genus are known only from North American fresh-water fishes; the genus contains the following species: *Actinocleidus articularis* (Mizelle, 1936), from *Xenotis megalotis* (Rafinesque); *A. bursatus* (Mueller, 1936), from *Micropterus salmoides; A. fusiformis* (Mueller, 1934) (syn., *Ancyrocephalus cruciatus* of Cooper, 1915), from *Micropterus dolomieu* Lacépède; *A. gracilis* Mueller, 1937, from *Lepomis pallidus* (Mitchill); *A. maculatus* Mueller, 1937, from *Eupomotis gibbosus* (Linn.); and *A. oculatus* (Mueller, 1934), from *Eupomotis gibbosus* (Linn.).

Genus Aristocleidus Mueller, 1936

Diagnosis.—Large hooks of haptor dissimilar, those of ventral pair with slender, angular blades and biramous roots, while those of dorsal pair have curved blades and only slightly biramous roots; haptoral bars non-articulating; 14 marginal hooklets present. Cirrus with immovable accessory piece. Vagina present, opening on right body margin. Other characters as in *Cleidodiscus*.

Type species.—*Aristocleidus hastatus* Mueller, 1936.

This genus contains only the type species which occurs on the gills of *Roccus lineatus* in Florida. Mueller (1936) in his description of this form was in error as regards the position of the large hooks and in the number of marginal hooklets. The large hooks which he termed the ventrals are actually the dorsals and *vice versa;* there are 14 marginal hooklets instead of 12 as originally given.

Genus TETRACLEIDUS Mueller, 1936

Diagnosis.—Haptor small, poorly set off from body. Large hooks about equal in size; bars non-articulating. Marginal hooklets probably 14 in number. Vagina present, opening on right body margin. Other characters similar to those of *Cleidodiscus.*

Type species.—Tetracleidus banghami Mueller, 1936.

This genus contains only the type species which occurs on the gills of *Micropterus dolomieu* Lacépède. It is questionable whether the genus *Tetracleidus* should be regarded as distinct from *Cleidodiscus,* since apparently the only important difference between the two genera is the position of the vaginal aperture.

Genus LEPTOCLEIDUS Mueller, 1936

Diagnosis.—Haptor small, poorly set off from body. Large hooks approximately equal; bars rudimentary, non-articulating; marginal hooklets probably 14 in number. Cirrus long, slender, lying in a large coil and passing to exterior through a grooved cuticularized vestibule or accessory piece. Vagina (?). Other characters as in *Cleidodiscus.*

Type species.—Leptocleidus megalonchus Mueller, 1936.

The type and only species of this genus occurs on the gills and in the throat of *Micropterus dolomieu* Lacépède. This species appears to be the form described by Cooper (1915) as *Ancyrocephalus paradoxus.*

Genus UROCLEIDUS Mueller, 1934

Diagnosis.—Haptor wedge shaped; large hooks of about equal size; bars non-articulating; marginal hooklets relatively small, 14 in number. Vagina absent. Other characters as in *Cleidodiscus.*

Type species.—Urocleidus aculeatus (Van Cleave and Mueller, 1932) Mueller, 1934.

The genus *Urocleidus* contains two valid North American species, *U. aculeatus* (Van Cleave and Mueller), from *Stizostedion vitreus* (Mitchill) and *U. adspectus* Mueller, 1936, from *Perca flavescens* (Mitchill).

Urocleidus angularis Mueller, 1934, from *Fundulus diaphanus menona* (Jordan and Copeland) was recently removed by Mueller (1936) from this genus to *Ancyrocephalus,* the latter being used in a general sense. The writer has studied the original specimens of *U. angularis* and is in agreement with Mueller that this species does not belong in *Urocleidus s. str.;* however, he sees no reason why it should be transferred to *Ancyrocephalus,* since it is more closely related to *Urocleidus* than to *Ancyrocephalus.*

Genus ONCHOCLEIDUS Mueller, 1936

Diagnosis.—Haptor wedge-shaped, with 2 pairs of large hooks and 2 non-articulating bars; 14 marginal hooklets present, these hooklets relatively large, 6 pairs being arranged around anterior edge of haptor and having their tips directed forward. Cirrus corkscrew-shaped, or simple with spiral fin, usually with immovable accessory piece. Vagina, when present, opening on right body margin. Other characters as in *Cleidodiscus*.

Type species.—*Onchocleidus ferox* (Mueller, 1934) Mueller, 1936.

This genus contains at present 11 species, all being from North America; these are: *Onchocleidus contortus* Mueller, 1937, from *Micropterus salmoides; O. distinctus* Mizelle, 1936, from *Xenotis megalotis* (Rafinesque); *O. ferox* (Mueller, 1934), from *Eupomotis gibbosus* (Linn.); *O. helicis* Mueller, 1936, from *Micropterus salmoides; O. interruptus* Mizelle, 1936, from *Morone interrupta* Gill; *O. mimus* Mueller, 1936, from *Lepibema chrysops* (Rafinesque) and (?) *Esox reticulatus* Le Sueur; *O. mucronatus* Mizelle, 1936, from *Helioperca incisor* (Cuv. and Valenc.), *Allotis humilis* (Giard), and *Eupomotis gibbosus* (Linn.); *O. perdix* Mueller, 1937, from *Lepomis pallidus* (Mitchill); *O. principalis* Mizelle, 1936, from *Micropterus pseudaplites* Hubbs; *O. similis* Mueller, 1936, from *Eupomotis gibbosus* (Linn.); and *O. spiralis* Mueller, 1937, from *Eupomotis gibbosus* (Linn.).

Genus PTEROCLEIDUS Mueller, 1937

Diagnosis.—Each large haptoral hook with wing-like blade arising near angle and passing parallel to point for about two-thirds its length. Vagina present, opening on right body margin. Other characters as in *Onchocleidus*.

Type species.—*Pterocleidus acer* (Mueller, 1936) Mueller, 1937.

In addition to the type species, which occurs on the gills of *Eupomotis gibbosus* (Linn.), this genus contains *P. acuminatus* (Mizelle, 1936) from *Xenotis megalotis* (Rafinesque); and *P. biramosus* Mueller, 1937, from *Lepomis pallidus* (Mitchill).

Genus HAPLOCLEIDUS Mueller, 1937

Diagnosis.—Large haptoral hooks similar but unequal, those of ventral pair about one-half as large as those of dorsal pair. Vagina present (?always), opening on left body margin. Other characters similar to those of *Onchocleidus*.

Type species.—*Haplocleidus dispar* (Mueller, 1936) Mueller, 1937.

This genus contains six species, namely, *Haplocleidus affinis* Mueller, 1937, and *H. dispar* (Mueller, 1936), from *Eupomotis gibbosus* (Linn.); *H. furcatus* Mueller, 1937, from *Micropterus salmoides; H. monticellii* (Cognetti de Martiis, 1925), from *Haustor catus* (Linn.); and *H. siluri* (Zandt, 1924), and *H. vistulensis* (Siwak, 1932), from *Silurus glanis* Linn.

The species described by Siwak (1932) as *Ancyrocephalus vistulensis* does not differ from *H. siluri* (Zandt), except in the number of marginal hooklets and in the character of the vagina. According to Zandt (1924) there are 16

marginal hooklets in *H. siluri*, whereas Siwak states that there are only 12 in *H. vistulensis;* apparently both figures are incorrect, the probable number in both cases being 14. Siwak states that the vagina is non-cuticularized in *H. siluri* and cuticularized in *H. vistulensis*. In spite of the differences mentioned above, the two species are identical in other respects, and both are from the same host and from the same region (Poland).

The species which Cognetti de Martiis (1925) described as *Ancyrocephalus monticellii* was collected in Italy from an American catfish. In this species the hooks of the dorsal pair were stated to be the largest; however, it seems probable from the description and figure of the bars and hooks that he was mistaken in the position of these structures, and it is on this assumption that the species is included in the genus *Haplocleidus*.

Genus AMPHIBDELLA Chatin, 1874

Diagnosis.—Body greatly elongated, fusiform; 3 pairs of head organs. Haptor lobed, distinctly set off from body proper, with 2 pairs of large similar hooks and 14 marginal hooklets; large hooks not supported by cuticular bars. Intestinal branches not united posteriorly. Eyes absent. Testis and ovary in anterior part of body, the latter elongated and curved, lying partly in extraintestinal field. Vitellaria confined to region posterior to ootype. Vagina present.

Type species.—*Amphibdella torpedinis* Chatin, 1874.

The genus *Amphibdella* contains only two species, *A. torpedinis* Chatin, 1874, and *A. flavolineata* MacCallum, 1916, the latter being a North American form.

Amphibdella flavolineata MacCallum, 1916 Figs. 1–4

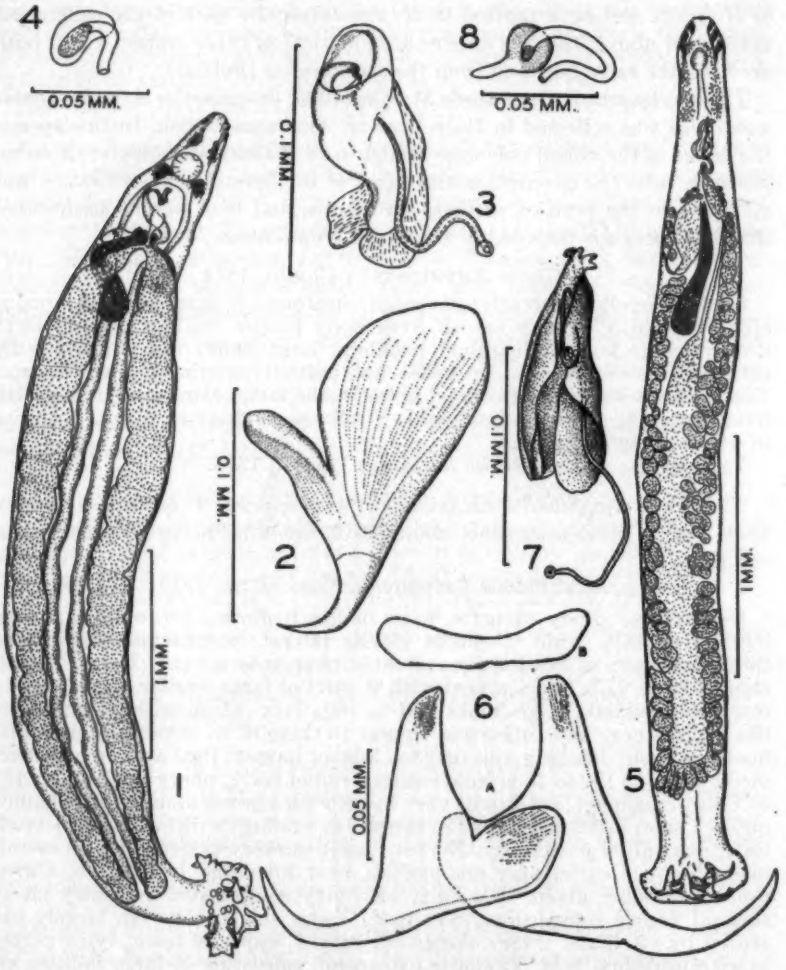
Description.—Body elongate, more or less fusiform, 3.8 to 4.3 mm long by 510 to 680μ wide. Cephalic glands lateral, prepharyngeal, opening through 3 pairs of head organs situated near anterior end. Haptor lobed, about 425 to 475μ wide, armed with 2 pairs of large similar hooks and 14 marginal hooklets; large hooks 150 to 160μ long, blade without shoulder-like process near base, otherwise similar to those of *A. torpedinis;* marginal hooklets about 10μ long, one on each lobe of haptor. Oral aperture ventral, median, about 190 to 230μ from anterior end of body; pharynx globular, 133 to 152μ in diameter; esophagus very short, with a group of unicellular glands on each side; intestinal branches simple, extending to distal limits of vitellaria, not united posteriorly. Nervous and excretory systems not observed; eyes absent. Genital aperture median, near intestinal bifurcation. Cirrus slender, tubular, about 100μ long, with very complicated accessory piece; seminal vesicle conspicuous, S-shaped. Testis single, sinistral, largely obscured by vitellaria. Ovary elongated, curved, opposite testis, lying partly in extraintestinal field. Vitellaria extracecal, consisting of large follicles arranged in linear series and extending from level of base of ootype to near posterior end of body proper. Vagina present, heavily cuticularized, near right margin of body immediately anterior to ovary, connected with a relatively large seminal receptacle. Ootype relatively slender, its base surrounded by unicellular glands. No eggs observed.

Host.—*Tetranarce occidentalis* (Storer) and "sting ray."

Location.—Gills.

Distribution.—United States (Woods Hole, Mass.).

Specimens.—U. S. N. M. Helm. Coll. Nos. 35159 (cotypes), 35204 and 35699.



Figs. 1–4.—*Amphibdella flavolineata.* 1, Complete worm, ventral view; 2, large haptoral hook; 3, cirrus and accessory piece; 4, vagina. Original. Figs. 5–8.—*Amphibdelloides maccallumi.* 5, Complete worm, ventral view; 6, haptoral hooks and bar (A—large hooks, B—bar); 7, cirrus and accessory piece; 8, vagina. Original.

Specimens of this species were collected by Dr. G. A. MacCallum at Woods Hole, Mass., July 6, 1914, and on August 21, 1922, from a torpedo,

Tetranarce occidentalis and later, July 20, 1923, a single specimen was collected by him from a "sting ray." This species is quite similar to *Amphibdella torpedinis* Chatin from which it differs principally in the morphology of the large hooks. In *A. torpedinis* the blade of the large hook is slender and widens more or less abruptly shortly before joining with the root or biramous portion, thus giving rise to a shoulder-like offset, while in *A. flavolineata* the blade of the hook is not so slender and tapers uniformly from the tip to the point of union with the root. This difference is, admittedly, slight, but constant so far as the writer has been able to ascertain. This shoulder-like offset is clearly shown in the figures of *A. torpedinis* as given by Chatin (1874) and by Ruszkowski (1931). In addition to the hooks, there appears to be considerable difference in the male copulatory organ.

Genus AMPHIBDELLOIDES Price, 1937

Synonym.—*Amphibdella* Chatin, 1874, in part.

Diagnosis.—Haptor not lobed; large hooks supported by a single cuticular bar. Other characters as in *Amphibdella*.

Type species.—*Amphibdelloides maccallumi* (Johnston and Tiegs, 1922).

Amphibdelloides maccallumi (Johnston and Tiegs, 1922), n. comb. Figs. 5–8

Synonyms.—*Amphibdella torpedinis* Perugia and Parona, 1889, not Chatin, 1874; *A. torpedinis* MacCallum, 1916, not Chatin, 1874; *A. maccallumi* Johnston and Tiegs, 1922.

Description.—Body slender, 1.1 to 3.5 mm long by 255 to 476μ wide. Cephalic glands abundant, forming a band across body anterior to pharynx and extending backward on each side to near level of genital aperture, opening to exterior through 3 pairs of head organs situated near anterior end of body. Haptor not lobed, 210 to 425μ wide, armed with 2 pairs of large hooks and 14 marginal hooklets, the large hooks supported by a single cuticular bar; large hooks 133 to 170μ long, shape similar to those of *Amphibdella flavolineata;* marginal hooklets about 10μ long; cuticular supporting bar slightly curved, 64 to 95μ by 19μ, concavity directed anteriorly. Oral aperture ventral, median, about 133 to 170μ from anterior end of body; pharynx globular, 76 to 95μ in diameter; esophagus relatively long. Nervous and excretory systems not observed; eyes absent. Genital aperture median, near intestinal bifurcation. Cirrus slender, tubular, about 175μ long; accessory pieces 2 in number, one with single curved tip and other tridigitate, about 130 to 160μ long. Testis elongate, median. Ovary elongate, slightly curved, median, pretesticular. Vitellaria lateral, consisting of large follicles uniting and forming a band across body at level of tips of intestinal ceca. Vagina slender, heavily cuticularized, opening near right margin of body at level of middle of ovary, and communicating with a large seminal receptacle lying along right margin of anterior part of ovary. Ootype and metraterm not discernable in available specimens. No eggs observed.

Hosts.—*Tetranarce occidentalis* (Storer) and *Squalus acanthias* Linnaeus.

Location.—Gills.

Distribution.—United States (Woods Hole, Mass.).

Specimens.—U. S. N. M. Helm. Coll. Nos. 35700 (cotypes), 25701 and 35652.

This appears to be the species described as *Amphibdella torpedinis* by Perugia and Parona (1889) and later redescribed by Parona and Perugia (1890) from specimens obtained from *Torpedo marmorata* in the Mediterranean region. Perugia and Parona show that the large haptoral hooks are supported by a single transverse bar, but in the redescription they report the species as having 2 bars; this latter report appears in the light of the present study to be an error.

The specimens upon which the above description is based were collected by Dr. G. A. MacCallum at Woods Hole, Mass., and described by him in 1916 as *Amphibdella torpedinis* Chatin.

This species resembles *Amphibdella torpedinis* and *A. flavolineata* in a general way but differs from them in having an unlobed haptor and large hooks supported by a transverse cuticular bar.

Genus TETRANCISTRUM Goto and Kikuchi, 1917

Diagnosis.—Anterior end with 2 to 3 pairs of head organs. Haptor small, not distinctly set off from body proper, with 2 pairs of similar, and almost equal, large hooks supported by 2 cuticular bars, and sometimes, if not always, with (?) 14 marginal hooklets. Intestine united posteriorly. Eyes absent. Vagina present.

Type species.—*Tetrancistrum sigani* Goto and Kikuchi, 1917.

Tetrancistrum longiphallus (MacCallum, 1915), n. comb. Figs. 9–11

Synonyms.—*Diplectanum longiphallus* MacCallum, 1915; *Ancyrocephalus longiphallus* (MacCallum, 1915) Johnston and Tiegs, 1922.

Description.—Body more or less fusiform, 1.4 mm long by 255μ wide; cephalic glands opening through 2 pairs of head organs. Haptor 133μ wide, not distinctly set off from body proper, provided with 2 pairs of large hooks supported by 2 transverse bars, and with a number, possibly 14, marginal hooklets. Large hooks about equal in size, 57μ long, differing only slightly in morphology; ventral bar 53μ long, narrow, bifid at ends; dorsal bar 38μ by 15μ; marginal hooklets very delicate, about 10μ long. Oral aperture ventral, about 95μ from anterior end of body; pharynx 75μ long by 53μ wide; intestine not observed. Eyes absent. Cirrus simple, tubular, about 140μ long; seminal vesicle curved, to left of ootype. Testis elongate oval, somewhat lobed, about 300μ long by 95μ wide, postequatorial. Ovary oval, about 150μ long by 60μ wide, immediately pretesticular. Vitellaria extending from level of pharynx to about 250μ from posterior end of body, meeting in median field posterior to testis. Vagina present, opening near right margin of body near level of base of cirrus. Ootype elongated, its base surrounded by long-necked unicellular glands. Egg oval, about 75μ long by 50μ wide, with relatively long filament at one pole.

Host.—*Chaetodipterus faber* (Broussonet).

Location.—Gills.

Distribution.—United States (New York Aquarium).

Specimens.—U. S. N. M. Helm. Coll. No. 35702 (cotypes).

This species was described under the name *Diplectanum longiphallus* by MacCallum (1915) from specimens collected from the gills of a spade fish, January 23, 1915, at the New York Aquarium. The material consists of a

few badly preserved and distorted specimens, only one specimen being in a suitable condition for description. A comparison of the available specimens with the description as given by MacCallum shows that the original description is inadequate in many respects. The measurements are not in agreement with those obtained by the present writer, the mouth is ventral instead of terminal, and no eyes are present; the cirrus is much shorter than MacCallum's measurements indicate, being about 140μ long instead of 250μ and the egg is about 75μ long instead of 20μ as stated by MacCallum.

A comparison of this species with descriptions of *Tetrancistrum sigani* Goto and Kikuchi (1917) from *Siganus fuscescens* Houttuyn from Japan, and of *T. lutiani* Tubangui (1931) from *Lutianus lioglossus* (Bleeker) from the Philippines, indicates that *Diplectanum longiphallus* MacCallum belongs in the genus *Tetrancistrum* rather than in *Diplectanum*, or in *Ancyrocephalus* where it was placed by Johnston and Tiegs (1922). The small size of the haptor, the similarity of the anterior and posterior hooks, the stalked Mehlis' glands, and the absence of eyes are characters which suggest affinities with *Tetrancistrum* rather than with *Ancyrocephalus;* the absence of squamodiscs alone excludes this species from *Diplectanum.*

Tetrancistrum longiphallus may be easily distinguished from the other two species of *Tetrancistrum* on the morphology of the large haptoral hooks and of the ventral bar. The hooks of *T. longiphallus* have blades more widely curved and longer than those of the other species, and the ventral bar is bifid at the extremities instead of rounded as in *T. sigani.*

Goto and Kikuchi (1917), as well as Tubangui (1931), state that the marginal hooklets of the haptor are absent in the genus *Tetrancistrum.* In *T. longiphallus* marginal hooks were found to be present although the exact number was not ascertainable; these hooklets are very small and transparent, and could be definitely detected only after careful study under an oil immersion objective. The fact that these hooklets are difficult to detect suggests that they were overlooked by the above mentioned authors.

GENUS INQUIRENDUM

DACTYLODISCUS Olsson, 1893

Diagnosis.—Cephalic glands and head organs (?); haptor pedunculated, lobed, with 2 pairs of hooks, the dorsal hooks being the largest, and having a peculiarly-shaped middle piece; marginal hooklets (?). Eyes present. Testis and ovary entire, equatorial. Cirrus simple. Vagina (?).

Type species.—Dactylodiscus borealis Olsson, 1893.

This inadequately characterized genus was proposed by Olsson (1893) for *D. borealis*, a species, found on the gills of *Thymallus vulgaris* and *Coregonus lavaretus.* Johnston and Tiegs regard *Dactylodiscus* as a subgenus of *Ancyrocephalus,* but owing to the inadequacy of the description of the type and only species, the writer prefers to retain it as a *genus inquirendum* until a more complete description is available.

Subfamily DIPLECTANINAE Monticelli, 1903

Synonym.—Lepidotreminae Johnston and Tiegs, 1922.

Diagnosis.—Body, especially posterior half, covered with anteriorly directed scale-like spines; cephalic glands present, opening to exterior through head organs. Posterior haptor with accessory structures (dorsal and ventral) or "squamodiscs," consisting of sessile or subsessile discs covered with concentric rows of scale-like spines, or of lamellae, with or without accessory hooks; haptor with 2 pairs of large hooks and basal supporting bars, and usually, if not always, with 14 marginal hooklets. Intestinal branches ending blindly, without diverticula. Eyes present, 2 pairs. Cirrus simple or complex. Testis and ovary without lobes. Vagina present.

Type genus.—*Diplectanum* Diesing, 1858.

KEY TO GENERA OF DIPLECTANINAE

1. Squamodiscs consisting of concentric rows of paired lamellae..... ..... *Lamellodiscus* Johnston and Tiegs
   Squamodiscs consisting of concentric rows of scale-like spines or spine-like hooks.....2
2. Squamodiscs with backwardly projecting groups of spine-like hooks.... ..... *Lepidotrema* Johnston and Tiegs
   Squamodiscs without spine-like hooks..... *Diplectanum* Diesing

Genus DIPLECTANUM Diesing, 1858

Synonyms.—*Acleotrema* Johnston and Tiegs, 1922; *Lepidotes* Johnston and Tiegs, 1922; *Squamodiscus* Yamaguti, 1934.

Diagnosis.—Squamodiscs consisting of concentric rows of scale-like spines, without groups of accessory spine-like hooks. Large hooks of haptor supported by 3 transverse cuticular bars. Vagina present or (?) absent.

Type species.—*Diplectanum aequans* (Wagener, 1857) Diesing, 1858.

The genus *Diplectanum* has been considered as identical with *Ancyrocephalus* by most recent writers, including Johnston and Tiegs (1922), Fuhrmann (1928), Van Cleave and Mueller (1932) and Sprehn (1933). A review of the status of *Diplectanum*, however, indicates that it must be retained as a genus distinct from *Ancyrocephalus*.

Diplectanum was proposed as a genus (not as a subgenus as Maclaren (1903) stated) by Diesing (1858) to include *Dactylogyrus aequans* Wagener, 1857, and *D. pedatum* Wagener, 1857. The genus was defined by Diesing as follows: "*Plectana* duo sessilia vel pedicellata.—*Piscium* marinorum ectoparasitica.—Characteres reliqui ignoti."

The two species *D. aequans* and *D. pedatum*, which Diesing included in this genus, were named but not described by Wagener (1857a) who later in the same year (1857b) gave a brief characterization of these species; this description was barely generic but apparently enough to validate the species. Diesing did not designate a type for his genus *Diplectanum* and inasmuch as he listed *D. aequans* first, Stiles and Hassall (1908) have indicated that species as "probably type," therefore, for all intents and purposes *D. aequans* (Wagener) may be regarded as type by subsequent designation.

Apparently the reason that *Diplectanum* has not been more generally

recognized as a valid genus was owing to the very meagre characterization of the species included in that genus, but if one regards Wagener's (1857b) description as sufficient to validate the species, as the present writer does, the genus must also be regarded as valid. Wagener's description is as follows:

"Dactylog. aequans (Branch. Labrax lupus) und pedatus (Julis spec. inc.) haben statt einer Schwanzscheibe deren zwei; die Innenfläche dieser Organe ist mit in konzentrische Kreise gelegten Stäbchen bekleidet."

"Die beiden Schwanzscheiben sind durch einen 3gliedrigen Apparat getrennt, dessen äussere Enden die scheerenartig gegeneinander beweglichen 2 grossen Hakenpaare tragen."

"Die grossen Haken haben stets häutige Scheiden, deren Oeffnung meist von einer festen Einfassung umgeben ist."

Van Beneden and Hesse (1863), Stossich (1896) and Maclaren (1903) have given descriptions of a species from *Labrax lupus*, which they regard as *D. aequans*. These descriptions are of a worm the characters of which conform to those given above for *Diplectanum*, and in view of the fact that the worm described by these different authors was from *Labrax lupus*, the same host as that reported for *D. aequans* by Wagener, and from the same general geographic region, the writer believes that the species they had before them was *D. aequans* (Wagener).

In view of the above, it appears that Johnston and Tiegs, as well as the other writers who have apparently followed their action, erred in considering *Diplectanum* as a synonym of *Ancyrocephalus*, since the type species *A. paradoxus*, of the latter genus lacks the two accessory structures (squamodiscs) which are characteristic of *D. aequans* and, accordingly, of the genus *Diplectanum*.

The genus *Diplectanum* contains the following species: *D. aculeatum* Parona and Perugia, 1889; *D. aequans* (Wagener, 1857); *D. americanum* n. sp.; *D. collinsi* (Mueller, 1936); *D. echeneis* (Wagener, 1857); *D. fluviatilis* (Johnston and Tiegs, 1922); *D. girellae* (Johnston and Tiegs, 1922); *D. longipenis* (Yamaguti, 1934); *D. pedatum* (Wagener, 1857); and *D. sciaenae* Beneden and Hesse, 1863. Of these species, *D. pedatum* from *Julis* sp.; *D. sciaenae* from *Sciaena aquilla; D. aculeatum* from *Corvina nigra;* and *D. echeneis* from *Chrysops aurata, Sargus rondeletii* and *Pagrus vulgaris* are inadequately described, although they probably are distinct species. Only two species, *D. collinsi* (Mueller) from *Roccus lineatus*, and *D. americanum* n. sp., are known to occur in North America.

Diplectanum americanum, n. sp. Figs. 12–15

Description.—Body elliptical, 765μ to 1.1 mm long by 210 to 390μ at level of ovary; posterior part of body armed with anteriorly directed scale-like spines extending forward almost to level of testis; anterior end of body rounded; cephalic glands present, opening to exterior through 4 pairs of head organs. Posterior haptor 170 to 190μ wide, with dorsal and ventral

squamodiscs, and armed with 2 pairs of large hooks supported by 3 transverse cuticular bars, and with 14 marginal hooklets. Squamodiscs subsessile, about 120μ in diameter, each consisting of 20 concentric rows of scales; hooks of ventral pair 76μ long, those of dorsal pair 50μ long; lateral supporting bars 76μ long, middle bar 114μ long, marginal hooklets about 10μ long. Oral aperture ventral, about 117μ from anterior end of body; pharynx about 38μ in diameter; intestinal branches not observed. Brain immediately anterior to pharynx; eyes present, 2 pairs, those of anterior pair smaller than those of posterior pair. Genital aperture not observed; male copulatory organ conspicuous, consisting of a simple cuticular tube (cirrus) 38μ long and a reniform, apparently heavily cuticularized structure (?) ejaculatory bulb) 87μ long by 38μ wide, divided by septa into 4 compartments. Testis globular, about 45μ in diameter, slightly postequatorial. Ovary piriform, 38μ wide, partly overlapping testis. Vitellaria extending from level of posterior margin of pharynx to within short distance of anterior margins of squamodiscs. Vagina present; Mehlis' gland conspicuous, surrounding ootype. No eggs observed.

Host.—*Promicrops itaiara* (Lichtenstein).

Location.—Gills.

Distribution.—United States (New York Aquarium).

Specimens.—U. S. N. M. Helm. Coll. No. 35703 (type and paratypes).

The above description is based on 5 stained and mounted specimens, collected by Dr. G. A. MacCallum, September 3, 1914, from *Promicrops guttatus* (=*P. itaiara*) at the New York Aquarium. Owing to the rather poor condition of the specimens, some of the details could not be made out. This species is easily distinguished from all other species of the genus by the peculiar structure of the male copulatory organ.

Genus LEPIDOTREMA Johnston and Tiegs, 1922

Synonyms.—*Flabellodiscus* Johnston and Tiegs, 1922; *Empleurodiscus* Johnston and Tiegs, 1922.

Diagnosis.—Dorsal and ventral squamodiscs composed of concentric rows of scale-like papillae, each with a number of backwardly projecting spine-like hooks arranged in a fan-like manner; large hooks of haptor supported by 4 cuticular bars articulating with a more or less complex central piece. Vagina present or absent.

Type species.—*Lepidotrema therapon* Johnston and Tiegs, 1922.

This genus and the subgenus *Flabellodiscus* (also used in the sense of a genus by Johnston and Tiegs), as well as *Empleurodiscus*, were proposed by Johnston and Tiegs (1922) for small monogenetic trematodes occurring on the gills of Australian fresh water fishes of the genus *Therapon*. These genera were regarded as distinct on the basis of characters such as the width of the haptor in comparison with body width, on the number of accessory spine-like hooks of the squamodiscs, and on the complexity of the male copulatory organs. In the writer's opinion these characters are of specific rather than generic value, and *Flabellodiscus* and *Empleurodiscus* are dropped as synonyms of *Lepidotrema*.

The genus as here constituted contains the species *Lepidotrema therapon*

Johnston and Tiegs, from *Therapon carbo* Ogliby and McCulloch; *L. tenue* Johnston and Tiegs, 1922, from *T. hilli* Castelnau; *L. fuliginosum* Johnston and Tiegs, 1922, from *T. fuliginosus* Macleay; *L. simplex* (Johnston and Tiegs, 1922), from *T. fuliginosus* Macleay; *L. angustus* (Johnston and Tiegs, 1922), from *T. unicolor* Gunther; and *L. bidyana* Murray, 1931, from *Therapon bidyana* (Mitchell).

Genus LAMELLODISCUS Johnston and Tiegs, 1922

Diagnosis.—Dorsal and ventral squamodiscs consisting of numerous concentric rows of paired lamellae; large hooks of haptor supported by 3 cuticular bars. Vagina present.

Type species.—*Lamellodiscus typicus* Johnston and Tiegs, 1922.

In addition to *Lamellodiscus typicus*, which occurs on the gills of *Sparus australis* Gunther, Murray (1931) has described two species, *L. pagrosomi*, from *Pagrosomus auratus*, and *L. major* from *Sparus australis*. All three of the species are known only from Australia.

Subfamily BOTHITREMATINAE Price, 1936

Diagnosis.—Cephalic glands scattered throughout the preoral part of body and not arranged in lateral groups as in other members of family, opening to exterior through 4 pairs of cup-like head organs. Haptor disc-like, with 1 pair of large hooks separated by 2 cuticular bars, and with 14 marginal hooklets; in addition to hooks and other cuticular structures, a row of radially arranged tube-like cuticular structures are present near the margin of the haptor. Intestine single, sac-like. Eyes present. Testis single, postovarial. Vagina (?).

Type genus.—*Bothitrema* Price, 1936.

Genus BOTHITREMA Price, 1936

Synonym.—*Acanthocotyle* Monticelli, 1888, in part.

Diagnosis.—With characters of subfamily.

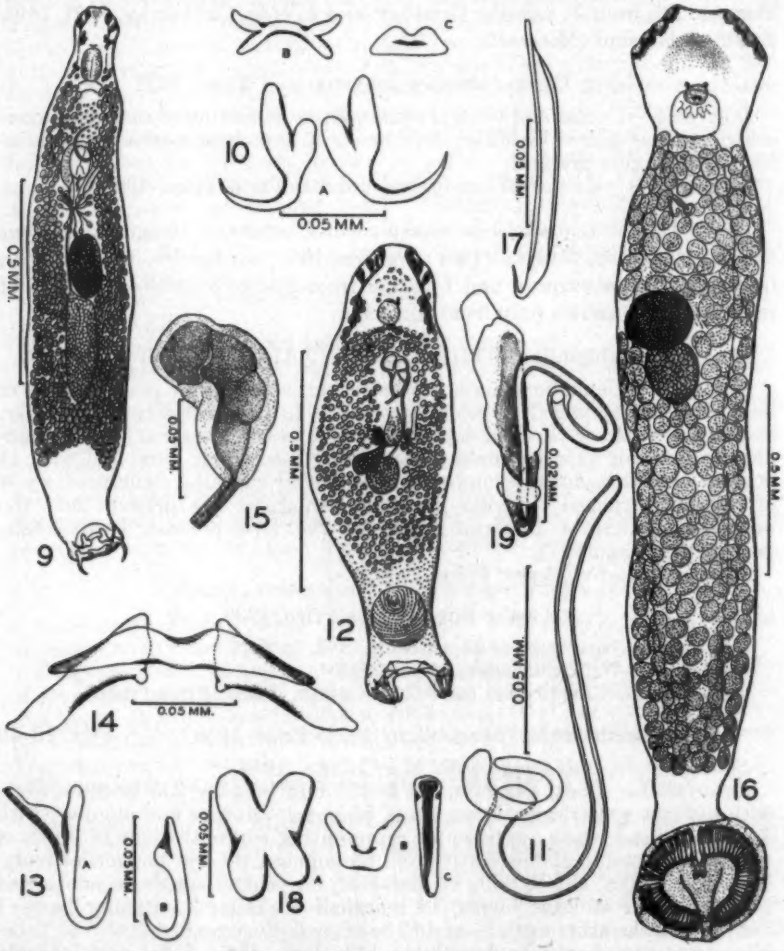
Type species.—*Bothitrema bothi* (MacCallum, 1913) Price (1936).

Bothitrema bothi (MacCallum, 1913) Price, 1936 Figs. 16–19

Synonym.—*Acanthocotyle bothi* MacCallum, 1913.

Description.—Body elongate, 1.4 to 2.5 mm long by 255 to 390μ wide, with distinct constriction in region of pharynx; anterior end angular, with 4 pairs of head organs apparently representing concentrations of ducts of numerous cephalic glands distributed throughout preoral portion of body. Haptor disc-like, 285 to 340μ in diameter, its ventral surface concave and bearing 1 pair of large hooks, 14 marginal hooklets, 2 cuticular bars—1 ventral and the other dorsal—and 52 to 60 radially arranged cuticular tube-like structures. Large hooks 120 to 133μ long, their distal ends sharply pointed and recurved, and separated near their tips by a U-shaped cuticular bar 20 to 25μ long by 22 to 30μ wide; ventral cuticular bar somewhat H-shaped, 57μ long by 40μ wide, located between bases of large hooks; radial cuticular structures 65 to 90μ long; marginal hooklets 15μ long. Oral aperture ventral, 114 to 200μ from anterior end of body; pharynx rectangular, 100 to 114μ long by 95 to 136μ wide, its anterior end with papilla-like

projections; intestine single, median, sac-like, extending posteriorly as far as limits of vitellaria. Brain antero-dorsal of oral aperture; eyes present, 2 pairs, one pair close together and immediately dorsal of oral aperture and the other pair farther apart and at level of anterior margin of oral opening,



Figs. 9–11.—*Tetrancistrum longiphallus*. 9, Complete worm, dorsal view; 10, haptoral hooks and bars (A—large hooks, B—ventral bar, C—dorsal bar); 11, cirrus. Original. Figs. 12–15.—*Diplectanum americanum*. 12, Complete worm, ventral view; 13, large haptoral hooks (A—hook of ventral pair, B—hook of dorsal pair); 14, haptoral bars; 15, copulatory organ. Figs. 16–19.—*Bothitrema bothi*. 16, Complete worm, ventral view; 17, large haptoral hook; 18, supporting structures of haptor (A—ventral bar, B—dorsal bar, C—one of tube-like accessory structures); 19, cirrus and accessory piece. Original.

or slightly more anterior to that point. Genital aperture ventral, median, about midway between ovary and pharynx; cirrus simple, tubular, about 75μ long, with complicated accessory piece about 55μ long. Testis single, globular, 130 to 170μ in diameter, median, immediately postovarial. Ovary globular, 150 to 170μ in diameter, about one-third of body length from anterior end and to right of median line; Mehlis' gland voluminous, immediately preovarial. Vitelline follicles numerous, large, about 40 to 50μ in diameter, extending from level of base of pharynx to near posterior end of body. Vagina not observed. Egg triangular, 50μ wide, and with polar filament, according to MacCallum.

Host.—*Lophopsetta maculata* (Mitchill).

Location.—Gills.

Distribution.—United States (Woods Hole, Mass.).

Specimens.—U. S. N. M. Helm. Coll. No. 35186 (cotypes), 35704, 35705 and 35706.

This species was originally described by MacCallum (1913) as *Acanthocotyle bothi* from specimens collected in 1912 from *Bothus maculatus* (=*Lophopsetta maculata*). The description contained a number of errors of interpretation of the various structures, which he later (1916) attempted to correct. Unfortunately, however, he carried over into the redescription many of the errors originally made. The most outstanding of the misinterpretations not corrected in the latter description were in regard to the number of testes, the character of the intestine, and the nature of the radial structures on the posterior haptor. According to MacCallum (1913) "there are about thirty-seven testes," but actually there is only a single testis located immediately posterior to the ovary and this is the structure labeled "seminal reservoir" in his figure; the structures which MacCallum regarded as testes were the large vitelline follicles lying over the intestinal cecum and which, owing apparently to some error of technique, took the stain somewhat differently from the other follicles. The intestine consists of a single sac-like structure and not 2 ceca as indicated by MacCallum. The radial structures on the posterior haptor are not "really hooklets" as MacCallum stated, but are rather heavily cuticularized tube-like pieces imbedded in the haptor.

This species is apparently an aberrant member of the Dactylogyridae standing in a position intermediate between that family and the Monocotylidae. Its lack of laterally arranged cephalic glands suggests affinities with the Monocotylidae, but the presence of cuticular supporting bars between the large hooks excludes it from that family.

MacCallum's inclusion of this form in the genus *Acanthocotyle* was apparently due to a misconception, since he regarded the tube-like structures on the posterior haptor as structures comparable to the radially arranged spines on the pseudohaptor[2] of *Acanthocotyle*.

[2] The large terminal disc of *Acanthocotyle* is probably not homologous with the haptor of the tristomes, monocotylids and gyrodactylids, but is an added structure, the true haptor being the minute hook bearing disc located at the margin of the large disc or pseudohaptor.

Family CALCEOSTOMATIDAE (Parona and Perugia, 1890) emend. Price, 1937

Synonym.—Calceostomidae Parona and Perugia, 1890.

Diagnosis.—Cephalic gland ducts not concentrated into head organs but remaining scattered over a considerable area on either side of anterior end of body, the anterior end being expanded and forming head lappets. Haptor sucker-like but not strongly muscular, with or without large hooks, with or (?) without marginal hooklets. Intestine with short diverticula. Eyes present or (?) absent. Testis single. Cirrus simple, cuticularized. Vagina present or absent.

Type genus.—*Calceostoma* Beneden, 1852.

KEY TO GENERA OF CALCEOSTOMATIDAE

Vagina absent.....*Calceostoma* Beneden
Vagina present.....*Fridericianella* Brandes

Genus CALCEOSTOMA Beneden, 1852

Diagnosis.—Anterior end of body expanded and forming large curled head lappets. Haptor cup-shaped, armed or (?) unarmed. Intestinal limbs with numerous short diverticula. Eyes present. Testis elongated. Ovary branched. Vagina absent.

Type species.—*Calceostoma calceostoma* (Wagener, 1857) Johnston and Tiegs, 1922.

This genus contains 3 species, *C. calceostoma* (Wagener, 1857) (syn., *C. elegans* Beneden, 1858), *C. inerme* Parona and Perugia, 1889; and *C. giandulosum* Johnston and Tiegs, 1922. No representative of the genus has been reported from North America.

Genus FRIDERICIANELLA Brandes, 1894

Diagnosis.—Head lappets not as prominent as in *Calceostoma*. Haptor cup-like, with 1 pair of small centrally placed hooks; marginal hooklets (?) absent. Eyes absent. Intestinal branches with lateral diverticula, united by commisure posterior to testis. Testis single, rounded. Ovary tubular, median. Vagina present, opening laterally near equator of body.

Type species—Fridericianella ovicola Brandes, 1894.

This genus contains only the type species which was described by Brandes (1894) from specimens collected from the eggs of *Arius commersonii* Lac., a fresh- and brackish-water fish from South Brazil.

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ENTOMOLOGY.—*Some neotropical and oriental syrphid flies in the United States National Museum.*[1] FRANK M. HULL, University of Mississippi. (Communicated by C. F. W. MUESEBECK.)

Several years ago the late Dr. J. M. Aldrich, to whom the writer owed much encouragement in his early studies of diptera, submitted an accumulation of exotic syrphid flies to the writer for study and identification. This material is almost entirely Neotropical in origin, although a certain amount of it comes from the Orient. It was later supplemented by material from the same regions, kindly made available for study by Dr. E. A. Chapin, to whom the writer is greatly indebted for extending the fullest facilities of the Museum. Finally, I wish to thank Mr. C. T. Greene for his helpful suggestions. The present paper presents the undescribed species of syrphids, the types of which are in the U. S. National Museum.

Volucella nitidigaster n. sp.

Male.—Eyes densely long black pilose, touching for a distance of length of antennae, with a bare horizontal band about the middle of each eye. The vertex, the greatly swollen front, face and cheeks brilliantly vitreus black, a small whitish pubescent area beneath the antennae, narrowly prolonged to each eye and on the eye margin intensified and slightly enlarged. There is a narrow brown stripe dividing cheeks and face, beginning at eye but not reaching the oral margin. Antennae, dark brown; arista pale, darker at apex, twenty to twenty-one rayed above. Tubercle of the short obconical face large, evenly rounded.

Thorax, scutellum, pleurae and abdomen strongly shining black with a bluish opalescent tinge. The thorax with a narrow anterior band of fairly long upright brassy pile, the remainder of the dorsum with short brassy pile obscured by dense long erect black pile. The lateral and calli bristles appear to be exceptionally long, stiff, shining black. Pile of mesopleurae long and brassy. Scutellum rather higher than usual, the margin without a definite depression but barely flattened at the apex on a small area, where it is also punctate or roughened. Scutellum conspicuous for the thick mass of long black pile on its dorsum basally, in the middle. Squamae black, with brassy fringe. Halteres ivory white. Abdomen with faint suggestion of a brownish area on either side on second and third segments.

Legs vitreus shining black, the mid and hind tarsi except terminal two joints dark brown.

Wings tinged on anterior joints with yellow. Stigma dark brown. Stigma cell light brown.

Length 6 mm.

One male. Villa Nogues, Pov. Tug. (R. A.) (1–1921)

Type in the U. S. National Museum, No. 51352.

Volucella punctigena n. sp.

Female.—Front and vertex, except for a shining black trifurcate spot above antennae and face, except for an obscure spot on either side just below

[1] Received January 16, 1937.

antennae, shining mahogany red and polished. The angle across from eyes at antennae, and the cheeks pale brownish yellow. The yellow of the cheeks is bordered behind and in front with a shining black stripe. Facial knob prominent and face descending to a distance below eyes equal to length of antennae from base to tip of arista. Antennae and arista light brownish yellow, the apical third of the latter blackish, with twenty-two to twenty-five rays dorsally. Eyes short pale pilose. Pile of head and face pale.

Thorax shining dark reddish brown, the whole middle anterior three-fourths shining jet black, its posterior margin produced as four vittae, their ends rounded, the outer pair the farthest, none reaching the scutellum. Pleurae blackish, the margins of some segments brownish. Scutellum light reddish brown shining, subtranslucent. Squamae and fringe pale brown. Halteres snow white. Scutellum with a deep depression, its base smooth, a few long black bristles on the margin.

Abdomen flattened, almost round, dark blackish in color, the disk of second, third and fourth segments purplish reddish, and the base of the second segment with two small pale yellow translucent triangles, their median and basal edges straight and forming a right angle. The pile of the abdomen short, very thick, whitish, quite erect.

Legs largely shining black, narrow apices of femora, basal half or third of tibiae and tarsi light brownish. Pile of legs black.

Wings strongly tinged with brown, especially on the veins and cross veins.

Length 9 mm.

One female. Siquinola, Guatemala.

Type in the U. S. National Museum, No. 51348.

Volucella albipilosa n. sp.

Male.—Eyes densely long white pilose, touching for the length of the antennae. Vertex, the swollen front, face, lower occiput and cheeks, except for a narrow shiny brown stripe from eye to oral margin, pale yellowish brown. Ocelli on a slightly raised blackish area. Pile of vertex and front thick, black, longer than that of the eyes. Face and cheeks with a few scattered black hairs on the upper middle of the former and upper posterior corners of the latter; elsewhere pale, appressed, brassy. Occiput from middle downward, long, white pilose, the whole densely punctate white pubescent. Antennae reddish brown, the third joint rounded, slightly concave above. Arista brown with twenty-five rays above. Face descending vertically below antennae to a faint tubercle, thence receding very slightly to the cone shaped tip of the epistoma.

Thorax largely and scutellum wholly shining light yellow brown, the anterior half of thorax with a large shining black spot, indented posterior-medially, and with a posteriorly directed continuation at each posterior corner. On the black area may be seen two short broad whitish pollinose vittae situated anteriorly. Pleurae shining black below, light brown above, its pile long and crinkly, pale, with a few tufts of black hairs. Pile of thorax long, anteriorly and narrowly at base of scutellum pale in color, elsewhere black. Lateral margins of thorax including humeri and post calli with several long black bristles, but none before the scutellum or on its margin. Scutellum without depression. Squamae and its fringe and stem of halteres dark brown; knob of the latter white.

Abdomen, its margin inrolled, almost entirely light reddish brown, the narrow posterior edge of the third segment, and apico median triangle, a very small basi median triangle on the second segment and the suggestion

of a narrow connecting vita black or blackish. First segment blackish. Venter the same light brownish color. The whole abdomen subtranslucent. The pile consists of conspicuous long white appressed tufts in each anterior angle of the third and fourth segments, and the very long erect surface pile of the fourth segment. Abdomen everywhere covered with short appressed black bristles.

Legs dark brown to blackish, black pilose or bristly, except that the tibiae posteroventrally and the tarsi ventrally are appressed golden pilose. Extreme apices of femora paler in color.

Wings hyaline, except for stigma, with four quite small dark brown spots on the cross veins in the middle of the wing.

Length 15 mm.

One male. San Martin, Mexico, May 27, 1922 (E. G. Smyth).

Type in the U. S. National Museum, No. 51357.

Volucella lunulifera n. sp.

Male.—Eyes densely long blackish pilose, widely touching. The small vertex swollen, the front and face and cheeks brilliantly vitreus black, a little silver pubescence beneath the antennae, a small spot of yellowish brown, triangular in shape near the eye margin of either side just below the level of the antennae, and a similarly colored narrow stripe dividing face and cheeks, beginning at the eyes and running to oral margin. Pile of face, cheeks, occiputal and front pale whitish; of vertex black. The face does not descend very deeply. It is bluntly obconical and the tubercle is large, oval and evenly rounded. Antennae dark brown. Arista paler, fifteen rayed above.

Thorax shining black, in places purplish and bluish opalescent. The scutellum shining vitreus black with a brassy cast, the marginal depression deep and conspicuous. Pile of thorax abundant, rather long, upright, pale brassy, with a few longer slender black hairs intermixed especially before the scutellum. Scutellum basally and marginally pale, the long marginal bristles black. Pleurae black, golden pubescent above, pale pilose. Squamae dark with blackish fringe, halteres pale yellow.

Abdomen shining black with an opalescent cast, with sharply defined pale yellow basal spots on the second segment, narrowly medially, oval on its posterior edge, i.e., subtriangular, and prolonged laterally part of the way down the sides. Third segment with similarly colored very small spots on anterior corners; fourth with a narrow lateral marginal stripe. Abdominal pile entirely erect, pale.

Legs shining black, very narrow apices of femora and bases of tibiae and the tarsi brown.

Wings hyaline, brownish anteriorly and an apical half, cross veins clouded, the stigma brown and the stigmal cell yellow.

Length 7.5 mm.

One male. Iquitos, Peru, Mar.–Apr. 1931 (R. C. Shannon).

Type in the U. S. National Museum, No. 51355.

Volucella cubomaculata n. sp.

Female.—Eyes very short pale pubescent. Front and vertex shining black, vitreus. The face and cheeks light clay brown or yellow, in the middle of the face with a narrow dark brown stripe from oral margin to antennae; a similar stripe, lighter in color, separating cheeks and face from eye to oral

margin, and another between cheeks and occiput. Face rather pointed, tubercle quite low, evenly rounded, not deeply excavated above. Antennae light reddish brown, arista darker, twenty-four rayed above.

Side of dorsum of thorax, pleurae, scutellum, except its margin darker, all light yellowish brown. The dorsum in the middle dark blue black, opalescent, with coppery lights. Bristles, including those of scutellum where the apical two are most prominent, and the prescutellar row, all black.

Pile of thorax exceptionally short, of quite appressed, brassy color; on the pleurae a little longer but similarly colored pile. A few short black hairs on scutellum. Squamae dark brown with brown fringe; halteres ivory knobbed.

Abdomen with first segment entirely and basal two-thirds of second pale subtranslucent yellowish brown. Third and fourth segment each with a pair of basal yellow spots not reaching the sides, widely separated medially, the last pair rather cubical in shape, the first pair more irregular in outline. Elsewhere the abdomen is shining blackish.

Legs dark brownish black, black pilose, all the femora a lighter shade of brown.

Wings with apical two-fifths grey or smoky, not diagonally marked, the basal part of the wing yellowish, the stigmal cell brownish grey.

Length 8 mm.

One female. Iquitos, Peru, Mar.–Apr. 1931 (R. C. Shannon).

Type in the U. S. National Museum, No. 51353.

Volucella lumina n. sp.

Female.—Eyes densely pale, short pilose. Front above antennae light brown, above and on vertex very dark brownish red, a median stripe black, everywhere shining. Face and anterior part of cheeks pale brownish yellow or clay yellow, vitreus, a narrow median stripe of reddish brown reaches from oral margin to antennal base, and a similar stripe separates cheeks and face and is followed by the same color on the posterior section of the cheeks. Occiput pale, very pale punctate-pollinose, and its pile pale. Short pile of front and vertex black and the whole top of the very large obtuse tubercle densely short black bristly. Face deeply excavated below antennae. Face short obconical. Antennae dark reddish orange infuscated apically. Arista pale, thirty-one to thirty-three rayed above.

Thoracic dorsum on the sides light brown, in the center widely black with a very strong bluish and coppery opalescence. Scutellum light brown, subtranslucent, opalescent. Pile of thorax short, brassy, subappressed, on the posterior half mixed with some black pile. Black lateral, scutellar and prescutellar bristles greatly strengthened and exceptionally long, at least as long as the scutellum in midline. Squamae pale brown with darker fringe. Halteres ivory white with brownish stalk. Pleurae brown, densely clothed in middle with long appressed brassy hairs.

Abdomen shining black with bluish opalescence on the base of the second segment with a pair of large, sharply graduate yellow, translucent spots, divided medially by a little less than their own thickness. Abdomen somewhat denuded but with both black and brassy hairs.

Legs everywhere very dark reddish brown appearing practically black, clothed with jet black bristles and pile. Wings much larger than abdomen, on outer diagonal half dark brownish; the brown widest posteriorly, the basal half of wing yellowish; all the veins brown.

Length 12 mm.

One female. Ramupasa, Bolivia, December (W. M. Mann) (Mullford Biological Expedition).

Type in the U. S. National Museum, No. 51349.

Microdon aurifacia n. sp.

Male.—Head shining black except on the sides of the face where it is dark mahogany brown. Face with abundant pale brassy pile directed downward, glittering. Occiput with similar but scanty pile. Vertex and front black pilose, a few pale hairs above the frontal depression. Antennae very long and slender, the first joint as long as second and third, the third five times as long as second. Arista concolorous, shorter than third joint. Eyes scanty, short pubescent below. There is a narrow bare vertical non pilose stripe on the face.

Thorax shining black, the anterior half covered with short appressed pale brassy pile, very dense and startlingly brilliant from in front. Posterior half with similarly appressed black pile. Pleurae dark mahogany colored, black pilose. Scutellum shining black with two very stout black spines, set fairly wide apart, at outer angles of scutellum, reddish in color, and cloaked with black pile. Scutellum deeply sulcate medially and about twice as wide as long in the sulcate midline.

Abdomen shining black, thick short, apically pointed, with flared basal margins on the second segment, its pile through the middle and on the lateral margins short appressed, pale, brassy; elsewhere black.

Legs, except the mahogany brown tarsi, entirely black; black bristly except on the ventral surface of all the tarsi, where it is golden brown, almost reddish. Posterior basitarsi flattened but not exceptionally large or thickened.

Wings smoky, especially on the apical half. A stump of a vein protrudes into the first posterior cell from the third longitudinal vein.

Length 15 mm.

Two males, one female. Itaquaquecetuba, Peru, Nov. 18 and Sept. 20. The female lacks the pale brassy pile, which is evidently a sexual character.

Type in the U. S. National Museum, No. 51370.

Allograpta flavomaculata n. sp.

Male.—Related to *Sphaerophoria micrura* O. S. The head bears a wider stripe of black on the face and front. The slant from oral margin medially to cheeks and occiput is greater, and the pile of the upper occiput is black in *flavomaculata* and white in *micrura*. Scutellum with a well marked hemicircle of black in the center. The scutellum of *micrura* is entirely pale. However, there are differences in the markings of the abdomen which are here described.

First segment with a very small yellow spot in the anterior basal corners of the segment. Second with a narrowly interrupted band in the middle of the segment, the band reaching the side margins, the median interruption short, that is, the inner ends of each spot, drawn out and tapering to an abrupt point. Third segment with a similar band, not interrupted, widest just back of lateral margin, the median area pointed sharply above and below, as if the band had been interrupted and bridged by a small oval longitudinal spot. Fourth segment with a still wider band practically as thick in the middle as near the sides. The outer third of this and the pre-

ceding band is directed posteriorward at an angle of forty-five degrees. Last segment with four small yellow spots, the inner pair sub-triangular, the right angle basal and medial.

Length 9 mm.

One male. Bogota, Colombia (B. Guevara, coll.)

Type in the U. S. National Museum, No. 51375.

Meromacrus vittata n. sp.

Female.—Vertex, middle stripe of front, shining black, the sides of the front long, yellow tomentose, the shining black face and cheeks obscured by pale whitish pollen, and long white pile. Occiput silvery pollinose, pale pilose. A few black hairs on vertex. Eyes bare. Antennae reddish brown, the dorsal edge of third joint blackish. The arista pale yellow with brownish tip.

Thorax obscurely shining black, with three very sharp continuous greyish yellow vittae, confluent just before the scutellum, and another on either side on the posterior half which does not reach beyond the suture. On the outer edge of the suture, and on the humeri, a conspicuous tuft of bright yellow tomentum. Pile of thorax and scutellum long, dense and yellow, the ground color of the latter pale brownish yellow subtranslucent. Squamae and halteres pale brownish yellow, the latter with a dark annulus on the stalk.

Abdomen shining black, metallic, the first segment grey dusted in the middle. The second third, fourth and fifth segments with narrow opaque yellow posterior margins, and the fourth post marginally with a reddish brown border or spot, not reaching the sides. Pile of abdomen extraordinarily appressed, except on the side margins, all pale in color. Legs entirely light reddish orange, pale pilose, the only black vestiture being the basi-spinules on the hind femora.

Wings hyaline; anterior margin pale brownish, the extreme base strongly orange brown.

Length 10.5 mm.

One female. Villa Nouges, Tug., Jan. 1929 (R. A.).

Type in the U. S. National Museum, No. 51953.

Meromacrus lineascripta n. sp.

Male.—Eyes bare, narrowly touching. Vertex raised and swollen. Ground color of head, except beneath facial stripe, shining black, the lower vertex, very narrow sides of front, and the face broadly, except for the wide bare middle stripe, and the cheeks narrowly along the posterior eye margins, all pale whitish pubescent or pollinose. The pile of the vertex is black. Elsewhere on the face it is snow white. Antennae dark greyish brown, the third joint but little longer than wide, the arista wholly pale yellow.

Thorax black, obscurely shining, a very narrow midline pale yellow pubescent, and a very narrow transverse band widely separated medially and not reaching either side, a continuous, slightly wider prescutellar band, covering calli and scarcely wider in the midline. A diagonal stripe runs from base of suture along inner edge of humerus, to extreme anterior thoracic margin, all pale yellow tomentose, almost white. Humeri bare. Scutellum blackish basally and on the sides, otherwise reddish, everywhere like the thoracic dorsum, thick, appressed short black bristly. Pleurae black, heavily whitish dusted. Squamae pale with darker fringe. Halteres cream colored.

Abdomen largely pale orange, the first segment, the base of the second

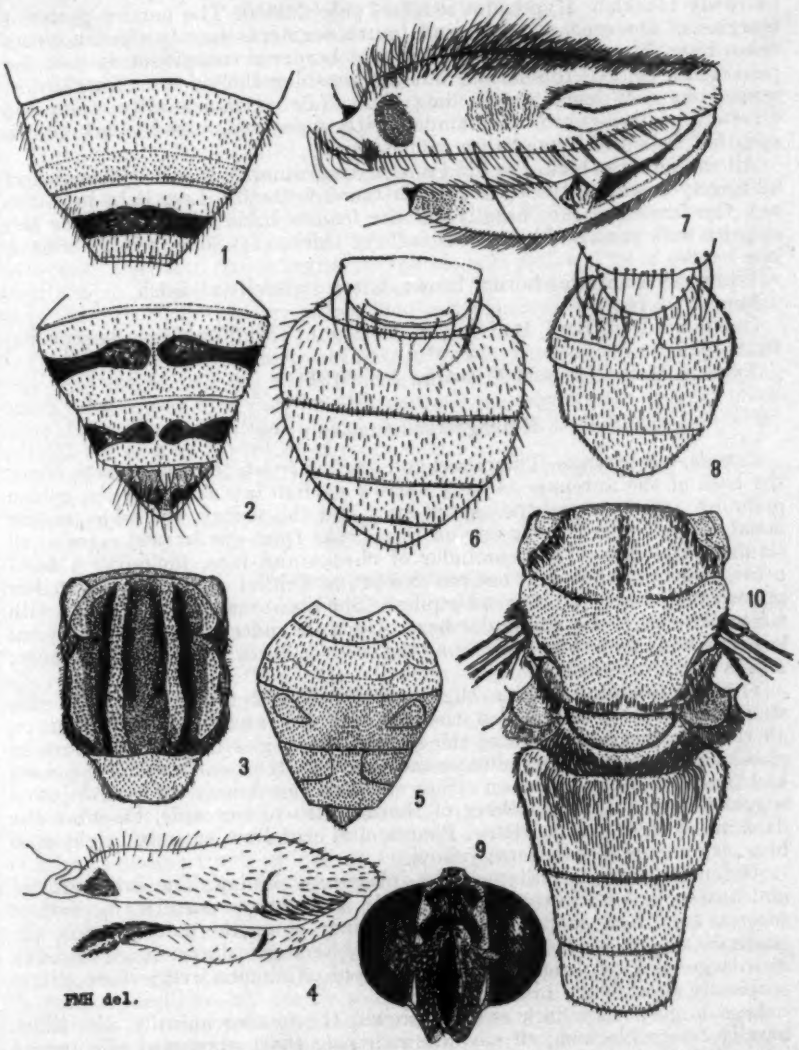

Fig. 1.—*Eristalis flavoscutellata* n. sp. (termination of abdomen). Fig. 2.—*Eristalis brevillosa* n. sp. (termination of abdomen). Fig. 3.—*Nausigaster nausicaa* n. sp. (thorax). Fig. 4.—*Eristalis brevillosa* n. sp. (hind femora). Fig. 5.—*Volucella cubomaculata* n. sp. (abdomen). Fig. 6.—*Volucella punctigena* n. sp. (abdomen and scutellum). Fig. 7.—*Eristalis flavoscutellata* n. sp. (hind femora). Fig. 8.—*Volucella lumina* n. sp. (abdomen and scutellum). Fig. 9.—*Braziliana vittithorax* n. sp. (front view of face). Fig. 10—*Meromacrus lineascripta* n. sp. (dorsum of thorax and abdomen).

narrowly blackish. Hypogium reddish, pale dusted. The narrow posterior margins of the second, third, and fourth segments faintly shining cream color, bare. The apex of the first segment bordered conspicuously with the pale cream colored tomentum, but not reaching the sides. Outer third of second segment basally with long black hair extraordinarily appressed directed posteriorward. Remainder with many appressed short golden spinules. Pollen of hypopygium ripple-like.

All the femora thick, the hind ones extraordinarily so, the thickening of all largely basal, on the third pair flattened ventrally. Legs light brownish red, the femora darker basally, all the femora basiventrally and the last sternite with remarkably curious tufts of thick, very long, crinkly whitish pile.

Wings with anterior border brown, the costal cell yellowish.

Length 12 mm.

One male. Ivon Beni, Bolivia (W. M. Mann) (Mullford Biol. Expedition, 1921–1922).

Type in U. S. National Museum, No. 51371.

Nausigaster nausicaa n. sp.

Female.—Eyes bare. The raised and swollen front, the square area about the base of the antennae, a very narrow median line bisecting the golden pollinose area between the square spot and the vertex, the wide median facial vitta, and a narrow one on the cheeks from eye to oral margin, all shining steel blue. The remainder of cheeks and face, including a band below antennae, the entire occiput except just behind vertex, densely yellow pubescent (pilose) and short pale pilose. The blue area above antennae with a few pale hairs, the remainder bare. Antennae quite large, the third joint twice as wide and twice as long as the second, all bright brownish orange. Arista bare, brownish.

Thorax brilliant steel blue, slightly purplish, with four conspicuous wide stripes or vittae of pale pollen, the outer one not interrupted at the suture, all running the full length of the thorax, the angles before the suture on either side with a yellow pollinose area and the stripe enclosed by the outer and inner pollinose vittae on either side is a rich brassy color with just a suggestion of bronze. Clothing of thorax ultra microscopic, black on the dark areas, light on the vittae. Pleurae and scutellum entirely bright steel blue. Squamae pale; halteres yellow.

Abdomen largely dark steel blue, obscurely shining. The first segment and base of second dusted with whitish. The narrow posterior borders of second, and third each continuing narrowly along the side margins, the posterior margin of the fourth more widely, triangularly produced medially as a large spot, all bright golden pubescent. Abdomen everywhere microscopically short black bristly.

Legs largely very dark reddish brown, the femora apically, the tibiae basally, more blackish, all covered with pale short appressed pile, except where it becomes golden on the posterior tarsi ventrically.

Wings clear hyaline. Stigma brown.

Length 7.5 mm.

One female. Montevideo, Uruguay (Tremoleras) Dec. 20, 1930. (Penarol). A remarkable and beautiful species.

Type in the U. S. National Museum, No. 51369.

Eristalis flavoscutellata n. sp.

Female.—Very close to *E. obscurus*. Front and vertex with black and yellow pile mixed, the former predominating. Face shining black, its pile pale. Facial knob prominent and bare. Antennae light brownish orange, dorsally blackish on the third joint. Arista reddish throughout, quite long and bare. Eyes very short whitish pilose.

Thorax and pleurae black, dully shining with long reddish yellow pile. Scutellum light brownish orange, with thick but rather short golden pile.

Abdomen large, swollen, shining black, the second segment on either side with obscure reddish, shining spots and suggestions of similar ones, but smaller, similarly placed on the third segment. Narrow posterior margins of second, third and fourth segments opaque pale yellow. Pile of second segments short, black and yellow intermixed; on third segment black; on fourth segment, except on the narrow base, entirely pale and erect. Only the black pile subappressed.

Legs with black femora, apices narrowly pale, the mid tibiae reddish, all the tarsi bright orange, orange pilose. Hind femora quite thick, shining black, with a few long pale bristles beneath and shorter thick erect black ones above. The hind tibiae black, with a dense dorsal (ventral when tibiae is adjacent to femora) fringe of black cilia.

Wings hyaline with a conspicuous quadrate brown spot in the middle.

Length 10.5 mm.

One female. Hiquito, San Mateo, Costa Rico (Pablo Schild).

Type in the U. S. National Museum, No. 51363.

Eristalis brevivillosa n. sp.

Female.—Vertex and front considerably swollen. The ground color is obscurely shining, dark brown above, becoming quite pale brownish yellow below on face. Front, vertex, face almost entirely covered with pale brownish yellow pollen, slightly darker on vertex, almost golden on the face, and obscurely punctate on the front. The antennae are small, set below the middle of the profile, and from base to vertex the front is thickly short black pilose. The eyes are very short yellow pubescent above, and there is some brassy pile on the upper part of the face. Tubercle medium sized, slightly more shining. Occiput from just past cheeks nearly to vertex is blackish, white dusted. The upper occiput exhibits a creased margin running to the corners of the eyes. Antennae pale brownish orange, the third joint oval. One and one-half times as long as wide. Arista pale, long, slender, bare.

Thorax black, dully shining, densely brown pollinose, two or three short median vittae are suggested but obscure on the anterior half; pile thick, short, nearly erect, brassy in color, becoming reddish on the lateral margins of the dorsum where the ground color is reddish brown. Pleurae black, whitish dusted, with tufts of long golden hairs on the upper mesopleurae. Scutellum large, broad, evenly rounded. Opaque rust red or rust yellow, its dorsum thickly beset with stubby black bristly hairs, a few golden ones laterally and ventrally on the margin. Squamae very large, reddish brown, its fringe yellow; halteres light yellow.

Abdomen very dark brown almost, but not quite black; mostly opaque, but with a shining jet black band interrupted medially on the middle of the third segment; a similar maculation on the fourth, both reaching the lateral margin, and both shaped somewhat on their inner ends as exclamation marks, the lateral tips of which are also dilated. Second segment with

a pair of small obscure reddish spots. First segment basally, on either side, pale yellowish white. Fifth segment shining black in posterior half, basally with a pair of small quadrate golden pilose spots, and similar ones more irregular in outline, similarly placed on the fourth segment.

Legs largely dark vitreus reddish, mahogany colored on posterior femora, the narrow apices of the face and mid femora, the bases of all the tibiae the first four more widely, pale yellowish. The tarsi are a lighter shade of dull yellowish brown. Hind femora not greatly thickened, but widest for a short distance before apex and sharply enlarged from this end. Hind tibiae flattened, slightly arcuated, but not ciliary fringed and not spurred apically.

Wings almost hyaline, yellowish tinged. Stigma sharply dark brown in color.

Length 10.5 mm.

One female. Lima, Peru, 2000+ ft. (Piches and Perene) Soc. Geogade.

Type in the U. S. National Museum, No. 51364.

Eristalis flavovillosa n. sp.

Male.—Eyes touching. The swollen vertex, front, face and cheeks black, the latter shining, the facial knob slightly shining, the remainder densely whitish grey pubescent. Facial tubercle rounded, low, inconspicuous. Antennae dark brown, the narrow base of the third segment light brown. Arista very long, thickened on basal third, brown in color, pale apically, and bare. Vertex, upper occiput, front and upper face covered with thick long shaggy, bright yellow pile. Eyes densely short whitish pilose.

Thorax black, obscurely shining, densely brown pollinose and very densely long shaggy yellow pilose, the pile erect, plush-like, bright in color, but nowhere golden. Scutellum similarly pilose, in color pale brownish yellow, obscurely shining. Squamae and fringe and halteres light brown.

Abdomen black, obscurely shining. On the second segment with a bluish coat, the sides of that segment in the middle with a light yellow spot or triangle, its posterior border horizontal, its inner angle acute. Posterior margins of first, second, third and fourth segment narrowly opaque yellow, the bases of the third and fourth and the yellow posterior margin of the fourth with a yellowish grey opaque band, equally narrow, all of them uninterrupted. With the exception of half a dozen long black bristles on either side of posterior margin of fourth segment, the pile is everywhere erect, very long, very dense, bright yellow. The pile of the venter is still longer, and paler.

Femora, except the narrow yellowish brown apices, shining black, about the middle brown pollinose. The hinder pair moderately thickened. Fore tibiae on apical half, mid tibiae on apical sixth, hind tibiae on apical three-fifths, blackish, remainder light brownish yellow, everywhere yellow pilose, except on the apical half of the hinder pair, which is black ciliated below. Hinder tibiae somewhat arcuated and flattened. All the tarsi brown, the hind tarsi lighter, the other dark. Pile of femora yellow. Hind femora apico-ventrally with long black bristles.

Wings largely hyaline, faintly brownish, especially about the center.

Length 14 mm.

Two males. Suifu, Szechuan, China (D. C. Graham, coll.).

Type in the U. S. National Museum, No. 51952.

Spheginobaccha melancholia n. sp.

Female.—Head shining black, the sides of the face, the cheeks, the narrow lateral eye margins of the front up to where a transverse band is formed in

the depression, all shining silver pubescent. The vertex and front especially the former, remarkably swollen and tumid, evenly rounded, the eyes at the posterior angles widely excavated so that the occiput is here quite thick. Antennae situated at upper two-thirds, without prominence, the third joint dark brown, a little longer than the first two evenly rounded and bearing a black bare, basally thickened arista. Pile of head scanty, short, everywhere pale except on the vertex. Ocelli placed far forward.

Thorax black, obscurely shining, with short dense reddish brown pubescence, and suggestions of two quite narrow vittae, and an equally narrow trace of a horizontal band across the suture and not interrupted in the middle. Scutellum and pleurae similarly colored and pubescent, the latter on the lower pleurae whitish. Squamae pale yellow; halteres light brown.

Abdomen black, shining, shorter than wings, with a pale obscure yellow spot of some size on either side of the second segment near the base. Pile of the abdomen largely pale. Some appressed black bristles on posterior borders of the segments.

Legs, black, the femora very narrowly at the apices, the basal halves of all the tibiae pale yellow. Hind femora slender.

Wings uniformly dark blackish or fumose, slightly paler posteriorly. Wings everywhere black pubescent.

Length about 15 mm.

Two females. Prang Bon, 30 mi. N. W. of Saigon, Cochin China, July 19, 1932, (M. Piolane, coll.).

Type in the U. S. National Museum, No. 51372; paratype in the author's collection.

Korinchia nova n. sp.

Female.—Vertex and front, except just above antennae, black, shining the upper portion of the latter pollinose (greasy in the specimen) and the extreme lower front shining brown. Face and cheeks light yellowish brown, interrupted by a shining dark brown stripe on the anterior portion of the cheeks from eye margin to oral margin. Antennae dark brown. Third joint oval, one and a half times as long as wide, unusually large. Arista very long, bare, basally yellowish, apically white. Eyes bare. The ocelli are situated on a raised area and the width of the vertex is less than the width of the third antennal joint.

Thorax black, obscurely shining, a band across from the humeri, jutting a little way posteriorly in the middle, another band on the sutures, interrupted widely in the middle, and a prescutellar band, pale yellowish grey pollinose. Scutellum tricolored, the narrow impressed rim pale greyish yellow, the middle light brown, the base black, all except the rim shining. Pile of thorax and scutellum short, rather thick, brassy in color, slightly longer before the scutellum, and still longer on the margin of the scutellum and with curious tufts of long flattened golden pile on the sides of posterior thoracic disk and calli, directed backward. Pleurae dark brown, largely bare, with a vertical stripe of pale pollen, pale pilose up the middle. Squamae whitish with yellow border. Halteres brownish yellow.

Abdomen black, obscurely shining, the lateral margins everywhere narrowly reddish and a triangular spot on the basal angles of the second segment narrowly meeting medially. The short dense bristles of the abdomen appressed, black on the black areas except that the basal borders of each segment are narrowly golden bristly. All segments including the first, with a

narrow posterior, opaque yellow pollinose border, golden appressed bristly. Side margin of abdomen with short brassy pile.

Legs largely pale yellow, waxy in appearance, except fore tarsi and tibiae blackish, the latter with postero-lateral hemicircle of pale yellow in the middle. Pile of legs short, largely pale. The hind femora apically, particularly beneath, black bristly, a few black bristles on the posterior tarsi, the anterior pair entirely so. Hind femora slightly infuscated postero-medially, quite slender, without tooth or spicules.

Wings nearly hyaline slightly yellowish basally. Stigma pale yellow.

Length 12 mm.

One female. Ningyuenfu, China (D. C. Graham, coll.).

Type in the U. S. National Museum, No. 51360.

Braziliana vittithorax n. sp.

Female.—Vertex quite swollen, brilliant shining metallic steel blue. Ocelli bright red. Eyes widely apart, bare. Whole face, where not pollinose, shining steel blue, glittering. The pollinose band of the face is ripple-like with large bare punctate spots, the outer margin of the metallic stripe coppery. Front across the middle black pollinose, trimaculate, leaving along each eye margin above and below the antennae, three whitish semi-oval pollinose spots. A conspicuous depression or trough transversely before scutellum. Facial pile pale. Vertical and upper frontal pile black, everywhere scanty. Antennae light brownish, blackish apically. First joint as long or longer than second and third; third pointed. Arista a little longer than third joint, basally pale.

Thorax opaque black trivittate, the outer vittae as broad wedges directed acutely backward, not proceeding past the suture anteriorly; the median one narrow, running full length; all three vittae confluent before the scutellum. Ground color on mid-dorsum steel blue, shining, whitish dusted anteriorly and around the shining anterior thoracic tubercle. Pleurae silver dusted except on the totally bare and brilliant pteropleurae (anterior part only). Scutellum shining metallic blackish. Squamae white with blackish border. Halteres brownish yellow.

Abdomen brownish black, a pair of oval, yellowish spots, pointed at either end, diagonally placed on the third segment, touching only the basal margin and widely separated. Suggestions of similar spots on the fourth and fifth segments which cannot be made out very definitely. Abdominal pile very short, scanty, pale.

Legs pale brownish yellow, the mid-femora, except narrow apex, the apical two-thirds of slightly thickened hind femora, and distal posterior tarsi blackish.

Wings hyaline, stigma brown.

Length 8 mm.

One female. Antigua, Guatemala, June 17, 1923 (E. G. Smyth).

Type in the U. S. N. M. No. 51376.

Obituary

WILLIAM MAJOR BEAMAN, Chief of Inspection and Editing of the Topographic Branch of the U. S. Geological Survey, died at his home in Washington, March 2, 1937. He was born February 20, 1867, at which time his father, the late Rear Admiral George Beaman, was stationed at Annapolis. After making a special study of Civil Engineering and Topographic Engineering at the Massachusetts Institute of Technology, he joined the U. S. Geological Survey in 1889 and was in charge of topographic field parties until he became inspector of field work, in 1907. With the exception of a furlough in 1922 for duty with the War Department, in Brazil, this position was held until the World War during which he served as major in the Corps of Engineers. In 1918 he was appointed to the position he held at the time of his death.

Major Beaman was the inventor of the Beaman arc used on telescopic alidades and transits and was author of the chapter of the Topographic Instructions of the Survey on topographic mapping used widely in colleges. He was a member of the Board of Surveys and Maps of the Federal Government, the American Society of Civil Engineers, the Society of American Military Engineers, the Washington Society of Engineers and the Washington Academy of Sciences.

CLARENCE BLOOMFIELD MOORE, noted American archeologist, died March 24, 1936, at his home in Philadelphia, Pa.

He was born in Philadelphia, January 14, 1852. After graduating from Harvard University in 1873, he traveled extensively in Eurasia, Africa and South America. His earliest published article described the ruined temple of Boro-Budur, in Java, then little known. An accident, while hunting big game, injured his eyesight and he turned to exploration of the mound cultures of the Southern States. His first work, on the shell heaps of the St. Johns River, Florida, appeared in the *American Naturalist*, 1892–1894. From then on two expeditions were made each year, with the summers devoted to preparation of the "Reports," which were published at Mr. Moore's expense in the *Journal of The Academy of Natural Sciences of Philadelphia* and freely distributed to the scientific world. One volume, privately printed, has been republished in *Indian Notes and Monographs* by the Heye Foundation.

In 1915, Mr. Moore graciously surrendered to the Heye Foundation all surveys and prospect data, prepared for his own further exploration of Red River, the gift thus making possible the work of M. R. Harrington on Caddoan Sites in Arkansas. Generous gifts of archeological objects, from time to time, enriched the collections of Peabody Museum at Harvard University, Phillips Academy, and other institutions, but the great C. B. Moore Collection was given to The Academy of Natural Sciences of Philadelphia, for the benefit of his native city. In 1929, with the reluctant consent of the donor, the Academy sold the collection to the Museum of the American Indian, Heye Foundation. The great body of material amassed in Mr. Moore's collection and accurately recorded in the twenty-two volumes of the "Reports" is an indispensable source of information and an inspiration to all archeologists working in the southeastern United States.

Mr. Moore was a member of the American Association for the Advancement of Science, the Anthropological Association, and many other American and foreign societies.

Reverend JULIUS ARTHUR NIEUWLAND, of the Congregation of the Holy Cross, died suddenly of a heart attack in the chemical laboratory of the Catholic University, Washington, D. C., on June 11, 1936.

Father Nieuwland was born on February 14, 1878, at Hansbeke, Belgium. While still a child, he was brought by his parents to this country, the family settling in South Bend, Ind. He received his A.B. in 1899 at the University of Notre Dame.

Father Nieuwland won distinction in two fields of science—biology and chemistry. In the latter his work was more recent and was perhaps more widely known, but, as Professor of Botany at the University of Notre Dame from 1904–1918, as the founder and first editor of the *American Midland Naturalist*, and as the author of about a hundred papers on the taxonomy of flowering plants and ferns his reputation as a botanist was well established. In 1918, Doctor Nieuwland became Professor of Organic Chemistry at the University of Notre Dame and was serving in that capacity at the time of his death. He was Dean of the College of Science, 1918–1922. Doctor Nieuwland's chemical studies were devoted largely to an extension of the work involved in the Doctor's dissertation entitled *Some reactions of acetylene*, which he had submitted in 1904 to the Faculty of the Catholic University of America. During eighteen years of chemical research he worked indefatigably and became an outstanding authority on the reactions of acetylene, the preparation of organic derivatives of acetylene and of other related compounds. These studies included the fundamental researches underlying the synthesis of duprene, one of the so-called synthetic rubbers; and the preliminary steps leading to the preparation of lewisite. As already noted, Father Nieuwland received the degree of Doctor of Philosophy from the Catholic University in 1904. The degree, Doctor of Science, was conferred upon him by the University of Notre Dame in 1911. In 1933 he was awarded the Morehead medal by the International Acetylene Association for outstanding work in acetylenes, and in 1935 was awarded the Nichols medal, the highest honor awarded by the American Chemical Society. At the presentation of the latter medal, Dr. J. M. Weiss, chairman of the jury of award, pointed out that Father Nieuwland at the risk of his own life had experimented with acetylene reactions—research shunned by most investigators because of the danger of explosion—until he so controlled these reactions that they could be studied in general laboratory work with comparative safety. In recognition of his achievements in the advancement of science he was awarded the Gregor Mendel medal by Villanova College a short time before his death.

On January 10, 1937, the University of Notre Dame held special memorial services in honor of her distinguished son and scientist.

ELIHU THOMSON, noted electrical engineer and director of the Thomson Research Laboratory at Lynn, Mass., died March 13, 1937.

Doctor Thomson was born at Manchester, England, March 29, 1853. He graduated from Central High School, Philadelphia, Pa., in 1870. In 1890 he received an honorary A.M. from Yale; an honorary Ph.D., Tufts College, 1896; an honorary Sc.D., Harvard, 1909, Manchester, 1924; and a LL.D. from the University of Pennsylvania, 1924.

From 1870 to 1880 he was professor of chemistry at Central High School, Philadelphia, and from 1880 he was electrician for the Thomson-Houston and General Electric Companies. At the Massachusetts Institute of Technology he lectured on applied electricity, and from 1920 to 1922 was acting

president of that institution. His researches and publications deal with the phenomena of alternating current induction, high potentials and high frequency apparatus, production of fused quartz, electric welding, and many other phases of applied electricity. For his great accomplishments he was honored with the Grand Prix, Paris, 1889–1900, and in succeeding years he was the recipient of the Scott, Rumford, Edison, Cresson, Fritz, Hughes, Kelvin, Franklin, and Faraday medals.

Doctor Thomson was a member of the National Academy, Franklin Institute, Philosophical Society, American Academy, and of numerous other American and foreign societies. He was a Chevalier and Officer, Legion d'honneur.

DR. WILLIAM ALANSON WHITE, for the past thirty-four years Superintendent of St. Elizabeth's Hospital and for many years a member of the Washington Academy of Sciences, died of influenza and pneumonia on Sunday, March 7, 1937, in his home at the institution of which he was the distinguished head.

Dr. White was born in Brooklyn, N. Y., January 24, 1870, the son of Alanson and Harriet Augusta White. He was graduated from Cornell University in 1889 and two years later received his M.D. degree from Long Island Medical College. While a student at Cornell, Dr. White's interest in psychology was aroused and fostered by his friendship with Dr. Bert G. Wilder, an eminent authority on the nervous system. This special interest in the human mind and its disorders led logically to the first professional work at the New York State Hospital at Binghamton, where he labored from 1892, the year after his graduation in medicine, until 1903. In that year, having become Second Assistant Superintendent of the Binghamton institution, he was called to assume full charge of St. Elizabeth's Hospital at Washington, D. C.

Nothing could more strikingly portray the exalted stature of Dr. White, both as administrator and as scientist, than the transformation of St. Elizabeth's Hospital during his life there. Coming as a young man of thirty-three years to assume charge of an institution long a football of politics and needing to rely exclusively upon politically controlled resources and personnel, he effected the necessary change of regime, rehabilitated and enormously extended its physical equipment, and made it a place of beauty and comfort. He sustained opposition and criticism, weathered the storms of transition, and survived accusations leading to numerous congressional investigations. Himself a leading factor in the renaissance of psychiatry, he was a pioneer in the practical application of the developing resources in that field until the old Government Hospital for the Insane, a mere custodial asylum for the hopeless, became one of the greatest institutions for the care and cure of the mentally ill, a training ground for many brilliant recruits to the psychiatric profession, and a research center of rich fruitfulness.

Dr. White's contributions to the literature of psychology and psychiatry were numerous and came in a steady stream throughout his professional life. Much of his earlier writing was in collaboration with Dr. Smith Ely Jelliffe, the volume on *Diseases of the nervous system* bearing both names. They were also associated in editing journals of psychology and psychiatry. One of the most important of Dr. White's books is *An outline of psychology*, written in 1909, and now in its fourteenth edition. His latest volume, *Twentieth century psychology*, was based on the material for the series of Salmon lectures he delivered before the New York Academy of Medicine.

Dr. White became Professor of Psychiatry at George Washington University in 1904 and taught the same subject to the students of the Army and Navy Medical Schools. He was a teacher wherever he appeared and his frequent contributions to the program of medical societies constituted a continuous post-graduate school for his professional associates. These activities led to recognition in the educational field by honorary degrees conferred upon him by Boston University, Washington University (St. Louis), Georgetown University, and George Washington University, the last at the convocation held February 22 of this year.

Dr. White was a Fellow of the American Medical Association and of the American College of Physicians; a member and former president of the American Psychiatric Association, the American Psychopathological Association, the American Psychoanalytical Association; also president (1930) of the International Congress on Mental Hygiene; sometime president of the Washington Institute of Mental Hygiene and of the Washington Academy of Medicine. His membership in the Washington Academy of Sciences resulted in several notable addresses before that body.